This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

B 482438 DUPL

GENERAL LIBRARY
OF
UNIVERSITY OF MICHIGAN

PRESENTED BY

From the University

189 1896

SCIENCE LIBRARY

QH
301
.L54

LELAND STANFORD JUNIOR UNIVERSITY PUBLICATIONS

87468.

CONTRIBUTIONS TO BIOLOGY
FROM
THE HOPKINS SEASIDE LABORATORY
IV

NEW MALLOPHAGA,
I,

WITH SPECIAL REFERENCE TO A COLLECTION MADE
FROM MARITIME BIRDS OF THE BAY OF
MONTEREY, CALIFORNIA.

BY

VERNON L. KELLOGG,

Associate Professor of Entomology, Leland Stanford Jr. University.

LELAND STANFORD JR. UNIVERSITY,
PALO ALTO, CALIFORNIA,
1896.

LELAND STANFORD JUNIOR UNIVERSITY PUBLICATIONS

CONTRIBUTIONS TO BIOLOGY

FROM

THE HOPKINS SEASIDE LABORATORY

IV

NEW MALLOPHAGA,

I,

WITH SPECIAL REFERENCE TO A COLLECTION MADE FROM MARITIME BIRDS OF THE BAY OF MONTEREY, CALIFORNIA.

BY

VERNON L. KELLOGG,

Associate Professor of Entomology, Leland Stanford Jr. University.

(Reprint from the Proceedings of the California Academy of Sciences, Series 2, Vol. VI.)

LELAND STANFORD JR. UNIVERSITY,
PALO ALTO, CALIFORNIA,
1896.

PREFATORY NOTE.

This memoir is the fourth of a series designed to illustrate the investigations and explorations of the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. The series is issued under the patronage of Timothy Hopkins, Esq., of Menlo Park, California. The present paper is published with the co-operation of the California Academy of Sciences, appearing simultaneously in its present form and as part of the Proceedings of the Academy.

CHARLES H. GILBERT,
OLIVER P. JENKINS,
Editors.

Date of publication, March 17, 1896.

AUTHOR'S PREFACE.

The following paper presents the descriptions and figures of one new genus and thirty-eight new species of Mallophaga, together with the identifications and figures of twenty-two species previously described by European authors, but now, with few exceptions, first determined as parasites of American birds. All of these species have been collected, mostly by the author, from water and shore birds. As this is the first American general systematic paper on the Mallophaga, the author has thought it desirable, for the sake of making the study of the group more accessible to American students, to present some statement of the present knowledge of this little-known but interesting order of parasitic insects. To this end there is offered a brief account of the structure, external and internal, of the life-history and habits, and of the zoological and geographical distribution of the parasites, together with a review of the literature of the group, and a statement of the present systematic treatment of the order, with a synopsis and tables of the families and genera.

Types of the new species described, will be placed in the collections of this University, in the collections of the California Academy of Sciences, and in those of the University of Kansas. The author has to express his obligations for services kindly rendered in connection with the preparation of this paper to President F. H. Snow and Librarian C. M. Watson of the University of Kansas; to Mr. Leverett M. Loomis, curator of birds for the California Academy of Sciences, whose aid in the collection and determination of birds is elsewhere referred to; to Miss Bertha M. Chapman, student of entomology; to Professor H. R. Fairclough, and to Miss Edna Hyatt, artist.

V. L. K.

Stanford University, February, 1896.

NEW MALLOPHAGA, I,—WITH SPECIAL REFERENCE TO A COLLECTION MADE FROM MARITIME BIRDS OF THE BAY OF MONTEREY, CALIFORNIA.

(With Plates ii–xv.)

BY VERNON L. KELLOGG.

CONTENTS.

- The Mallophaga: Introduction.
- Historical and Bibliographical.
  - European.
  - American.
- Structure.
  - External.
  - Internal.
- Life-History and Habits.
  - Immature Stages.
  - Parasitism.
- Distribution.
  - List of Hosts, with Parasites.
- Systematic.
  - Position among Insects.
  - Classification, with Keys.
  - Synopsis of Genera.
  - Terminology.
  - Account of Collections Examined.
  - Methods of Collecting and Preserving.
  - Descriptions of New Species, and Identification of Old Species.
  - Index of Species.
  - Explanation of Plates.

THE MALLOPHAGA—INTRODUCTION.

The Mallophaga constitute a small order of parasitic insects which live externally on the bodies of birds and mammals. The insects are small, one-tenth of an inch being perhaps an average length, wingless, and have biting mouthparts, with which they feed on the feathers or hair of their host, not sucking blood as the true lice do. They have an incomplete metamorphosis. The structure and habits of the insects have until recent years been very imperfectly understood—even yet the position of the group among insects is but provisionally established (see *postea)*, and the knowledge of the life history is strangely incomplete.

In America, besides some account of the commoner forms infesting domestic birds and mammals included in Professor Herbert Osborn's "The Pediculi and Mallophaga affecting Man and the Lower Animals" (Bull. No. 7, 1891, Div. of Ent., U. S. Dept. Agric.), and a discussion by Prof. A. S. Packard (Proc. Amer. Phil. Soc., 1887, vol. xxiv) of the position of the group among insects, practically nothing touching the systematic consideration of the group has been published.

Historical and Bibliographical.

European.—The Mallophaga are first recognizably mentioned in the writings of Redi (1668 and 1686), where the common *Trinoton luridum* of the ducks may be recognized in his "louse of the teal," and the common *Lipeurus baculus* of the pigeons is evidently the subject of his description of "*Pulex columbæ majoris.*" In the various writings of Albin (1720), Otto Fabricius (1780), J. C. Fabricius (1781, 1787, 1805), De Geer (1778), Linné (1746, 1789), Scopoli (1763), Schrank (1776, 1781, 1804), Panzer (1793), and others, curious accounts and brief descriptions of the common Mallophaga are to be found.

It is to the writings of Christian Ludwig Nitzsch, Professor of Zoology in the University of Halle, in the succeeding century, however, that we turn for a definite memoir which may be recognized as a real beginning of the systematic study of the Mallophaga. Nitzsch's "Die Familien und Gattungen der Thierinsekten (Insecta Epizoica) als ein Prodromus Naturgeshichte derselben," published in Germar's Magazin der Entomologie, vol. iii, 1818, Halle, presents the essential features of the classification of the group now used, and contains the earliest accepted nomenclature. Since the publication of this pioneer memoir four monographic works have been issued; together, needless to say, with numerous lesser memoirs containing descriptions of new species, compiled and more or less comprehensive conspecti of the group in text-books, and morphological treatises.

The monographs indispensable to the student of the Mallophaga are Henry Denny's Monographia Anoplurorum Britanniæ, or an Essay on the British Species of Parasitic Insects, 1842, London, illustrated with colored plates; Christoph Giebel's "Insecta Epizoa, die auf Säugethieren und Vögeln schmarotzenden Insekten, nach Chr. L. Nitzsch's Nachlass bearbeitet, mit XX Tafeln nach Nitzsch's Handzeichnungen," 1874, Leipzig; E. Piaget's "Les Pediculines, Essai Monographique, vol. i, Texte, vol. ii, Planches, 1880, Supplement, 1885," Leyden; and O. Taschenberg's "Die Mallophagen, mit besonderer Berücksichtigung der von Dr. Meyer gesammelten Arten," Nova Acta der Ksl. Leop.-Carol. Deutschen Akademie der Naturforscher, Band xliv, No. 1, 1882, Halle. Of these monographs Denny's is limited to a consideration of the parasites found on birds collected in England, his descriptions are too brief, and the colored figures too superficially drawn, so that it is often impossible to recognize from his description and illustration the species of parasite which he had under consideration. Giebel's monograph, as indicated in the title, is based on the unpublished descriptions and drawings of Nitzsch. Giebel also had access to the specimens collected and prepared by Nitzsch. The work is a monumental one, although many of the descriptions are incomplete, and the colored illustrations leave much to be desired in the way of accurate detail. Piaget's monographic essay is easily the most valuable treatise on the group, the descriptions being good, the uncolored figures in every way admirable, and the scope of the work truly monographic. Piaget has fairly attempted to include in his original essay a consideration of every species of Mallophaga described up to 1880. In his Supplement he publishes the descriptions of more than 100 new species which have come under his observation. Taschenberg's memoir is the first part of what he hopes to make a complete monograph of the group. It includes the genera *Goniodes*, *Goniocotes*, *Lipeurus*, *Ornithobius*, *Akidoproctus* and *Trichodectes*. The descriptions of new species are very complete, and the keys to species in the considered genera of great value; the illustrations only, though good, are not up to the exceptionally high standard of the work. Taschenberg, like Giebel, has had access to Nitzsch's types.

Of the lesser systematic memoirs Nitzsch's posthumous papers, edited by Giebel, in the Zeitschrift für gesammte Naturwissenschaft, vols. xvii, 1861, xviii, 1861, and xxviii, 1866, are the most important; all of their contents are, however, included in the Insecta Epizoa. Next in importance, as far as number of described species goes, are Rudow's papers, consisting of an inaugural dissertation (1869) and several articles in the Zeitschrift für gesammte Naturwissenschaft, 1869–1870. Rudow's descriptions are deplorably incomplete; Piaget has practically discarded them in his monograph. Of treatises on the Mallophaga to be found in text-books of general entomology, that in Burmeister's Handbuch der Entomologie, 1832, is markedly the most complete.

Finally, of morphological memoirs, those of Kramer on

Lipeurus jejunus (Zeitschr. f. wiss. Zool., 1869, vol. xix, p. 452), of Melnikoff on the embryology of the Mallophaga and of the Pediculidæ (Archiv f. Naturgesch., 1869, vol. xxxv, p. 136), and of Grosse on the anatomy of *Tetraopthalmus chilensis* [=*Menopon titan*] with some comparative studies (Zeitschr. f. wiss. Zool., 1885, vol. xlii, p. 530), are the most important. A full abstract of Grosse's paper was published by Macloskie in the American Naturalist, 1886, vol. xx, p. 340, and is thus readily accessible to American students.

A few descriptions of new species have been published recently by Piaget (Tijdschr. v. Ent., and Notes of the Leyden Museum), and by Picaglia (Atti d. Soc. Ital. di Sci. Nat., and Atti d. Soc. dei Nat. di Modena).

I append a bibliographic list of the more important systematic and morphological memoirs. Full bibliographic lists are to be found in the monographs of Giebel and Piaget. A good list is that published by Picaglia at the beginning of his paper, "Pediculini dell'Istituto anatomo-zoologico della R. Università di Modena," Atti d. Soc. dei Naturalisti di Modena, 1885, serie 3, vol. iv.

BIBLIOGRAPHY.

SYSTEMATIC.

ALBIN, ELEAZAR. A Natural History of English Insects, 1720, London.

BURMEISTER, HERMANN C. C. Handbuch der Entomologie, part I, 1835, Berlin.

DEGEER, CARL. Mémoires pour servir a l'histoire des Insectes, vols. v, vii, 1778, Stockholm.

DENNY, HENRY. Monographia Anoplurorum Britanniæ, 1842, London.

FABRICIUS, JOHANNES CHRISTIANUS. Systema Entomologiæ, 1775, Flensburg.

Species Insectorum, 1781, Hamburg.

Mantissa Insectorum, 1787, Copenhagen.

Systema Antliatorum, 1805, Brunswick.

FABRICIUS, OTTO. Fauna Groenlandica, 1780, Copenhagen and Leipzig.

GERVAIS, PAUL. Histoire Naturelles des Insectes aptères, 1847, Paris.

Giebel, Christoph. Insecta Epizoa. Die auf Säugethieren und Vögeln schmarotzenden Insekten, nach Chr. L. Nitzsch's Nachlass bearbeitet, 1874, Leipzig.

Grube, Adolph E. Beschreibung der auf A. Th. v. Middendorff Sibirischen Reise gesammten Parasiten, in Middendorff's Reise, vol. ii, part i, 1851, St. Petersburg.

Gurlt, Ernest F. Verzeichness der Thieren auf Welchen Schmarotzerinsekten leben, mit Hinzufügungen von Schilling. Arch. f. Naturgesch., tome xxiii, p. 276 et seq., 1857.

Uber die auf Haussäugethieren und auf Hausvögeln lebenden Schmarotzinsekten. Mag. f. d. ges. Thierheilkunde, vol. viii, p. 409; vol. ix, pp. 1-10, 1842.

Neues Verzeichniss der Thiere auf welchen Schmarotzerinsekten leben. Archiv. f. Naturgesch., vol. xliv, p. 162 et seq., 1878.

Linné (von) Carl. Systema Naturæ, 13th ed., tome I, vols. iv, v, 1789, Leipzig.

Megnin, Paul. Les Parasites et les maladies Parasitaires chez l'Homme, les animaux domestiques et les animaux sauvages avec les quels ils peuvent etre en contacte, 1880, Paris.

Murray, Andrew. Economic Entomology, Aptera, 1877 (?), London.

Nitzsch, Christian Ludwig. Die Familien und Gattungen der Thierinsekten (Insecta epizoica) als ein Prodromus Naturgeschichte derselben. Germar's Mag. d. Ent., vol. iii, pp. 261-316, 1818, Halle.

Panzer, Georgius W. F. Faunæ Insectorum Germanicæ, 1793, Nürnberg.

Piaget, Edmond. Les Pédiculines, Essai Monographique, 1880; Supplement, 1885, Leyden.

Description d'une nouvelle Pédiculine. Notes from the Leyden Museum, vol. xi.

Quelques nouvelles Pédiculines. Tijdschr. voor Entomologie, vol. xxii, p. 147 et seq., 1888, Hague.

Quelques Pédiculines nouvelles. Tijd. v. Ent., vol. xxxiii, p. 223 et seq., 1890, Hague.

Picaglia, Luigi. Intorno alla divisione del genere *Menopon* nei due sottogeneri *Menopon* e *Piagetia*. Atti della Società dei Naturalisti di Modena, ser. iii, vol. ii, p. 103 et seq., 1884, Modena.

Pediculini nuovi del Museo di Zoologia ed Anatomia comparata della R. Univ. di Modena. Atti della Società Italiana di Scienze Naturali, vol. xxviii, p. 82 et seq., 1885, Milan.

Pediculini dell' Istituto Anatomo-Zoologico della R. Univ. di Modena. Atti d. Soc. dei Naturalisti di Modena, ser. iii, vol. iv, 1885, Modena.

Redi, Francesco. Esperienze intorno alla generazione degli insetti fatti, 1668, Firenze. (Reprinted in Opusculorum, Pars I, 1686, Amstelodami.)

Rudow, Ferd. Beitrag zur Kenntniss der Mallophagen oder Pelzfresser, Diss., 1869, Halle.

Neue Mallophagen, Zeitschr. f. d. ges. Naturwiss. vol. xxxiv, p. 387, 1869.

Beobachtungen über Lebensweise u. Bau der Mallophagen o. Pelzfresser. Zeitschr. f. d. ges. Naturwiss. vol. xxxv, p. 272, 1870.

Schrank, Francesco di Paola. Enumeratio Insectorum Austriæ indigenorum, 1781, Augustæ Vindelicorum.

Scopoli, Joannes Ant. Entomologia Carniolica, 1763, Vindobonae.

Simonetta, Luigi. Elenco sistematico dei Pediculini appartenenti al Museo Zoologico dell' Univ. di Pavia. Bull. Soc. Ent. Ital., vol. xiv, p. 204 et seq., 1882, Florence.

Stephens, J. F. A Systematic Catalogue of British Insects, 1829, London.

Taschenberg, Otto. Die Mallophagen, mit besonderer Berücksichtigung der von Dr. Meyer gesammelten Arten. Nova Acta d. Ksl. Leop.-Carol. Deutschen Akademie f. Naturforscher, Bd. xliv, No. 1, with 7 plates, 1882, Halle.

White, Ad. List of the specimens of British animals in the collection of the British Museum. Part 17, Anoplura. London.

MORPHOLOGICAL.

Grosse, Franz. Beiträge zur Kenntniss der Mallophagen. Zeitschr. f. wiss. Zool., vol. xlii, p. 530, 1885.

Kramer, P. Beiträge sur Anatomie u. Physiologie der Gattung *Philopterus* Nitzsch. Zeitschr. f. wiss. Zool., vol. xix, p. 452, 1869.

Melnikoff, N. Beiträge zur Embryonalentwicklung der Insekten. Archiv f. Naturgesch., p. 136, 1869.

Wedl, D. Ueber das Herz von *Menopon pallidum*. Sitzungsb. Acad. Wiss. Wien., vol. xvii, p. 173, 1855.

American. As already mentioned in the Introduction, there are practically no American systematic papers on the Mallophaga excepting Professor Herbert Osborn's account of "The Pediculi and Mallophaga affecting man and the lower animals" (Bulletin 7, 1891, Division of Entomology, U. S. Dept. Ag.) Of this bulletin pages 30–54 treat of Mallophaga found on domestic mammals and birds, including the cat, dog, bear (sic), llama, goat, sheep, horse, mule, cow, guinea-pig, pouched gopher (sic), duck, goose, swan, chicken, pigeon, peacock, pheasant, guinea-fowl and turkey. Many of the species referred to in the bulletin have evidently been observed on animals in America by Professor Osborn, but just how many and what species are not told. One new species, *Trichodectes geomydis*, found abundantly on the Pocket Gopher, is described and figured. I find this species common on *Thomomys talpoides bulbivorous* in this State (California). Among the illustrations of the bulletin are twelve original ones, indicating that at least these twelve species have been personally observed by Professor Osborn.

In the American Monthly Microscopical Journal for November, 1894, Professor Osborn publishes a key to the genera, including in it all of the genera then known, excepting Westwood's *Ancistrona* and Taschenberg's *Eurymetopus* and *Bothoriometopus*.

In the American Naturalist, 1871, in a paper entitled "Certain Parasitic Insects," Professor A. S. Packard names, illustrates, and briefly describes seven new species of Mallophaga collected from American birds. Unfortunately neither the descriptions nor illustrations have been sufficient to enable any one of these species to be recognized by subsequent writers. Similarly Dr. Leidy in the Proceedings of the Academy of Natural Sciences of Philadelphia, refers in briefest terms to a *Menopon* taken from *Pelecanus erythrorhynchus* (Florida) and names it *Menopon perale* (see *Menopon titan*, this paper).

Of other American literature on the Mallophaga, there are in the Proceedings of the Boston Society of Natural History, 1851, brief abstracts of two papers read before the Society by Dr. W. I. Burnett on "the external parasites of warm-blooded animals" and "observations on the relations of an order of parasites (lice) to the different faunæ, as bearing, first on the distinct creation of types of animals, and second on the local creation of these types wherever they are found." Dr. Burnett noted that "although there are single species (of parasites) peculiar to particular animals, there are others which are found on different species of the same genus as is the case in the parasites living on birds of the genus *Larus* (Gulls) and the diurnal birds of prey." From an examination of the structure of these animals, Dr. Burnett was of opinion that they should be placed in an order by themselves, closely allied to the Insecta; "they number about 250 species, the mandibulate parasites occupying the highest and the haustellate the lowest position in the order." In the second paper Dr. Burnett makes a curious argument for the theory of a special creation of each species of animal based on the facts shown in his study of the distribution of their parasites.

Prof. A. S. Packard read at the meeting of the American Philosophical Society, September 2, 1877, a paper "On the Systematic Position of the Mallophaga," which was published in the Proceedings of the Society, 1887, vol. xxiv, p. 264. Prof. Herbert Osborn has published in Insect Life, 1890, vol. iii, p. 115, a "Note on the Period of Development in Mallophaga," and in the same journal, 1891, vol. iv, p. 187, a paper on the "Origin and Development of the Parasitic Habit in Mallophaga and Pediculidæ."

I append a list of the American papers.

BIBLIOGRAPHY.

BURNETT, W. I. Abstr. of paper read Feb. 6, 1850, in Proc. Bost. Soc. Nat. Hist., 1850, vol. iii, p. 240; abstr. of paper read Aug. 7, 1850, in same, p. 322.

PACKARD, A. S. "Certain Parasitic Insects," American Naturalist, 1870, vol. iv, p. 83, ill.

"On the Systematic Position of the Mallophaga," Proc. Amer. Philosoph. Soc., 1887, vol. xxiv, p. 264, ill.

LEIDY, J. Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 100.

MACLOSKIE, G. "Grosse's Classification and Structure of the Bird-lice or Mallophaga" (abstract), Amer. Nat., 1886, vol. xx, p. 340, ill.

KELLOGG, V. L. "Notes on the Mallophaga," Transac. Kansas Acad. Sci., 1889, vol. xii, part i, p. 46.

OSBORN, HERBERT. "Notes on Mallophaga and Pediculidæ," Canad. Ent. 1884, vol. xvi, p. 197.

"Note on the Period of Development in Mallophaga," Insect Life, 1890, vol. iii, p. 115.

"Origin and Development of the Parasitic Habit in Mallophaga and Pediculidæ," Insect Life, vol. iv, 1891, p. 187.

"The Pediculi and Mallophaga," Bull. No. 7, Div. of Ent. U. S. Dept. of Agric., 1891, ill.

"Collecting and Studying Parasitic Insects," Amer. Mo. Mic. Jour., 1894, vol. xv, pp. 56-59.

"Keys to the Genera of Pediculidæ and Mallophagidæ," Amer. Mo. Mic. Jour., 1894, vol. xv, pp. 344-346.

STRUCTURE.

EXTERNAL.—The characteristic external appearance of the Mallophaga is due to a structural condition incident to the parasitic habits of the insects. The body is small, wingless, greatly flattened and usually strongly chitinized. There are no indications of wings in any stage of the insect's life.

Head (fig. 7, plate ii). The head is large in proportion to the whole size of the body, flat (slightly convex above and slightly concave below), and variously crescentic, reniform, quadrangular, triangular, narrowly or broadly conical. It is usually sparsely haired, the hairs appearing specially along the acute lateral margins. The mouth parts and oral opening are on the under side of the head; and the antennæ are outstretched or concealed in excavations on the under side. The most conspicuous character of the fixed parts of the head, other than their extremely flattened condition, is the great development of the clypeus which usually forms the principal part of the head in front of the antennary insertions, and is prolonged as a flat, tapering or expanding, colored or partly uncolored plate, whose anterior margin, variously notched, roundly emarginated, truncated or convex, forms the frontal line of the head. The suture separating the clypeus from the epicranium is usually distinct or unmistakably indicated, sometimes indistinguishable. The hind-head is usually widest across the temporal region, the temples often being strongly expanded laterally with angulated or rounded margin. The occipital region is usually concave, so that the head sits "hat-like" on the prothorax. The head presents certain chitinous bands projecting forward from the occipital margin, inwardly from the eyes, forward from the bases of the antennæ, etc. The presence or absence and the character of these bands are used as distinguishing specific characters, and the bands are named and defined in the Terminology (see *postea*).

The antennæ (figs. 10, 11 and 12, plate ii) are short, 3-, or 4-, or 5-segmented and vary much in shape and character. They are filiform (suborder Ischnocera) or clavate or capitate (suborder Amblycera), and sometimes differ in the two sexes of the same species. When this is the case they are the antennæ of the male which depart from the typical condition, showing appendages on one or more segments, probably used for grasping the female. The antennæ arise from or near the lateral margins of the head, and usually from about the middle of the margin. The fossa may be deep or shallow; its angles projecting and acute or short and rounding; and the antennæ may project directly and always from the head (suborder Ischnocera) or they may lie concealed in excavations on the under side of the head (suborder Amblycera).

The eyes are simple and are located in the lateral margins of the hind-head not far behind the antennary fossæ, in a deep or shallow ocular emargination of the lateral margin, or on the non-emarginated margin. They are two in number, although each is sometimes slightly or almost completely divided by an angular emargination. They are flatly convex to hemispherical, and clear to strongly colored.

The mouth parts (figs. 7, 8, 9, plate ii), situated on the under side of the head, and variously from the middle of this aspect to the frontal margin, are fitted for biting and consist of rather large, strongly chitinized, usually two-toothed, usually sharply pointed mandibles, inconspicuous and as yet imperfectly known maxillæ without *palpi, and a labium of various character and size; either large and with 4-segmented palpi (family Liotheidæ) or small and without palpi (family Philopteridæ). Despite the good work of Grosse the knowledge of the mouth parts of the Mallophaga is still manifestly incomplete.

Thorax. The thorax, which is composed usually of but two segments (three in but three genera), the meso- and metathorax being indistinguishably coalesced, is flat, larger than broad, and variously shorter than the head to much longer than the head (in one species as long as the abdomen). The lateral borders of both sclerites are strongly chitinized. The metathorax sometimes closely resembles an abdominal segment and is often closely joined to the first abdominal segment. The prothorax usually bears one to a few stiff hairs on its lateral margins; the metathorax often bears in addition to the hairs almost always present in the lateral angles, a series of long, strong hairs ranged along the posterior margin. These hairs may arise from small uncolored (unchitinized) spaces and

---

*The earlier writers, Nitzsch *et al.*, ascribe the visible palpi to the maxillæ; Grosse is positive of their labial connection. A study of the anatomy of the Mallophaga, now being made in my laboratory, will, it is hoped, afford some further data on the mouth parts subject.

project upwards, being undoubtedly tactile organs. In the case of the three genera in which the mesothorax can be distinguished from the metathorax, this separation is especially evident in immature specimens, as would be expected in the case of a specialization by reduction.

The legs (fig. 13, plate ii) are strong and of variable length; the forelegs are the shortest and are used as foot-jaws for carrying food to the mouth. When at rest the forelegs project forward beneath the head. The coxæ are usually short (long and projecting beyond the lateral margins of the thorax in one genus) and are rarely appendaged. The femora vary from long, subcylindrical, to short, thick, subovoid; the tibiæ are usually shorter than the femora (sometimes as long, rarely longer) and slender, and are armed at the distal extremity with spines and sometimes, in the males, with special structures for holding the female. Both femora and tibiæ bear from a few to many short to long hairs; sometimes series of short, strong spines. The tarsi are 2-segmented, the distal segment with one (mammal-infesting forms) or two (bird-infesting forms) claws, the first segment of the tarsus is short and with or without one or two small lobes; the second segment is short (family Philopteridæ) or elongate and slender (family Liotheidæ) and bears a pulvillus between the claws.

Abdomen. The abdomen is flat, short, oval to long and slender, often differs in the sexes, especially in the shape and character of the posterior margin of the last segment, and is composed of 9 (sometimes apparently 8) or 10 segments. It may be almost naked or pretty thoroughly clothed with hairs, and bears almost always one to several short to long hairs in the posterior lateral angles of each segment, which angles sometimes project acutely. The hairs on the dorsal surface, as on the thorax, sometimes arise from small, circular, uncolored spaces, when they are said to be "pustulated." The last segment is variously elongate, short, with emarginate, truncate or convex posterior margin, which is evenly or unevenly fringed with short to long hairs. The lateral margins of thesegments are usually strongly chitinized, the chitin being sometimes translucent, but usually dark brown to black.

INTERNAL.—For our present knowledge of the internal anatomy of the Mallophaga we are indebted chiefly to Nitzsch, Kramer and Grosse. Among the points of special interest presented by the internal structure are the concentration of the nervous system and the differing types of crop in the two sub-orders.

Alimentary Canal (figs. 1 and 2, plate ii). The œsophagus of the Amblycera simply expands widely to form a crop; in the Ischnocera the crop appears as a conspicuous diverticulum or lateral sac of the œsophagus. The crop often bears spines or teeth on its inner wall. There are two pairs of salivary glands, variously cylindric, clavate, sub-spheroid, reniform, or divided into many small cylindrical tubes. The stomach usually presents two forward-projecting sac-like expansions. There are four thread-like, unbranched, Malpighian tubules.

Genitalia (figs. 4 and 5, plate ii). In the male there are paired testes, two sperm-ducts uniting to form an ejaculatory duct, accessory glands and a protrusible penis, with chitinized, often elongated, side-pieces. The female has paired ovaries ("three pairs of ovarian tubes in Liotheidæ, five pairs in Philopteridæ"), two oviducts uniting before issuance, and a seminal receptacle (called by Nitzsch "Kittdruse," but by Kramer and Grosse a receptaculum seminalis).

Dorsal Vessel. Kramer found the heart of *Lipeurus* *jejunus* to be a long delicate tube with expanded, turnip-like, posterior extremity. The "wing-muscles" are greatly reduced. There are but four openings for the ingress of the blood, which is not rich in white corpuscles. Wedl was able to study the heart of *Menopon pallidum*, but Grosse could not succeed in making preparations showing the heart of *Tetraopthalmus chilensis* [=*Menopon titan*].

Respiratory System (fig. 6, plate ii). In *Menopon titan* I have found six pairs of abdominal spiracles (segments 3–8) and a pair of prothoracic spiracles. There are two large longitudinal trunks and one large transversal trunk (segment 4 of the abdomen) in *titan*.

Nervous System (fig. 3, plate ii). There are two head ganglia, the supra-œsophageal and the infra-œsophageal, and three thoracic ganglia lying close together. There are no abdominal ganglia, the hindmost thoracic ganglion sending back into the abdomen two large nerves, whose branches provide the abdominal viscera with nerves.

LIFE-HISTORY AND HABITS.

The Mallophaga have an incomplete metamorphosis. The eggs are elongate-oval, are fastened singly by some gluey substance to the vanes or barbs of the feathers, and the young issue by breaking off a circular cap or lid at the larger free end of the egg. The duration of the egg stage has not been determined for any species. A number of eggs of *Nitzschia pulicare* (host, the Chimney Swift, *Chætura pelasgia*), collected by P. H. Rolfs (Ames, Iowa), and kept, some of them, "in a tight pasteboard box in his vest-pocket, the others enclosed in cotton-plugged tubes under a setting hen," incubated under these circumstances in from 13 to 20 days. The age of the eggs at time of collecting was not known. The young resemble the parents in essential characters; the noticeable differences are the comparatively larger head, the smaller, especially shorter, abdomen, and the absence or incompleteness of the markings, especially those of the abdomen. The color of the very young is always whitish; as they grow older chitinization follows and the brown and black colors appear (see plates). The number of moults or the duration of immaturity is not known for any species. I have observed nymphs (presumably in the stage preceding the final moult) which were fully as large as the adults of the same species. I have figured the immature stages for one or more species in nearly all the genera met with by me on the water and shore birds (see plates). In none of the monographic works is there any attention paid to the young. From the preceding brief account it is obvious that the life-history of the Mallophaga is as yet practically unknown.

Parasitism. The parasitic habits of the Mallophaga have been the subject of some little study, mainly directed to ascertaining whether or not the blood of the host ever forms a part of the food of the parasite. From the condition of the mouth parts and from repeated examination of the contents of the crop the food of the Mallophaga is affirmed to be the epidermal scales and the hair or feathers of the host. The conspicuous large, dark, pear-shaped blotch in the abdomen found in a majority of individuals examined is discovered, on careful examination, to be the crop and its contents, composed of bits of feathers showing through the semi-transparent body of the insect. In Nitzsch's drawings, illustrating the Insecta Epizoa, this food-filled crop appears in many of the individuals figured. Denny's figures also show the discolored crop. Of course such a "marking" is an evanescent one: immediately after a full meal it would be present; later, after digestion, it would be wanting. A few instances are recorded of the presence of blood in the crop, but it has been suggested, with much show of probability, that the blood was such as might not infrequently, because of wounds, be found by the parasite on the feathers, perhaps dried and hard. There is one instance, however, known to me among the habits of the parasites which cannot be so readily explained. *Menopon titan* var. *linearis* of the California Brown Pelican *(Pelecanus californicus)* is found commonly clinging to the inner surface of the gular pouch. The clinging is accomplished by the use of the mandibles, each parasite of the half dozen individuals which may be grouped together having its mandibles inserted in the skin of the pouch. The mandibles are not thrust in suddenly on touching the insect with the collecting forceps, but the insects are always, as far as observed, firmly lodged. Indeed some effective clinging would be necessary always to prevent the carrying away of the parasites by the water taken into the pouch of the pelican in feeding. In several instances a small region surrounding the parasites was raw and bloody. What is it that serves these parasites for food? Perhaps, of course, simply the epidermal scales of the inner wall of the pouch.

The abundance of certain species of Mallophaga, like *Menopon pallidum*, on domestic poultry causes the hosts much inconvenience and sometimes actual injury. The injury is done by the irritation of the skin of the host by the sharp-clawed feet of the hordes of parasites, rather than by any direct hurt through the feeding. After the death of the host, the parasites either attempt to leave the body, usually migrating slowly toward the head, or simply die on the body. The death of the parasites remaining on the body usually ensues in two or three days. I have observed the death of some in four or five hours, and, on the other hand, have collected live parasites from a bird skin seven days old. The death of the parasites can hardly be caused by starvation, in view of their feeding habits, but rather must be attributed to the lack of animal heat which they have been accustomed to during the life of the host.

Mallophaga which infest swimming and diving birds are not furnished with special contrivances for their pseudo-aquatic life. They, in fact, never come, necessarily, into contact with the water, living, as they do, at the roots of the feathers where the water can never penetrate, and where they have a constant and sufficient supply of air for the longest submergence possible to the host.

The origin of the parasitic habit among the Mallophaga and its influence on their structure are questions of much interest, but ones which cannot be touched on here.

Some of the phenomena of the relations of parasites to hosts, the migration of the parasites, and the influence of their peculiar habits on the rapid establishing of variations, are considered in the following paragraphs under the head of "Distribution."

DISTRIBUTION.

The Mallophaga are parasites which live for their whole life on the body of the host; only in rare instances are the insects to be found off the host's body. The common louse of the hen, *Menopon pallidum*, has been found walking on the roosts or elsewhere in the chicken houses. But the Mallophaga are not "stationary parasites" of that extreme type in which the organs of locomotion are lost; and the infesting of new hosts is accomplished by actual migration of individuals from one bird to another. It is obvious that for any one bird-species this migration may be readily accomplished: (a) from male to female, or *vice versa*, during copulation; (b) from parent to young, during the nesting season. In both of these cases there is actual contact of the hosts. If at other times in the life of the host it comes into actual contact with other birds of its own species migration of parasites can take place. Such cases must occur among birds of gregarious habits; the crowding together of gulls on small masses of floating sea-weed, or on masses of food, or on the rocks of the shore, must bring about actual contact of the bodies of the birds. But, as common observation shows, there are in the crowding groups of gulls individuals of different species. Thus in these cases there is possible a migration of parasites from one bird-species to another, these species in the case of the gulls being closely related ones—species belonging, in fact, to one genus. But on the "roosts" of maritime birds, the cliffs of the shore and the outlying rocks, birds of very different kinds sit huddled together. Along the rocky shores of Point Pinos on the Bay of Monterey, pelicans, cormorants and gulls gather in great numbers and perch side by side on favorite "roosts." It seems as if migration of parasites from one to another of these bird-species could here, and elsewhere under similar conditions, often be accomplished; and I have found *Lipeurus toxoceras*, described by Nitzsch from a cormorant, on both a cormorant and a pelican shot on this shore. Other cases of contact occur between birds of prey and their victims (I have noted a *Physostomum*, a genus confined normally to passerine birds, on a sparrow-hawk); and in those few groups of closely allied forms among which hydridization occurs, as with the ducks. Still other opportunities for accidental or normal contact between birds of different species will suggest themselves to the student.

The opportunities for migration so far referred to are sufficient to account for the spreading of a parasite species among individuals of its host species, and for the condition presented in cases like those of *Docophorus lari* and *Nirmus lineolatus* common to many species of gulls, and those of *Trinoton luridum* and *Docophorus icterodes* common to many species of ducks: cases where the birds are of gregarious habits, or where hybridization occurs.

But of those cases of a parasite common to two or more bird-species, one or more of which are Old World forms and the other or others New World forms, a further explanation is necessary. In this paper I ascribe to Mallophagous species described from specimens taken on birds of Europe or elsewhere not on the American continent specimens of twenty-two different species of Mallophaga taken on American birds. Examples of such occurrence are *Nirmus signatus* and *N. pileus* from the American Avocet *(Recurvirostra americana)* and described by Piaget and Nitzsch from specimens taken on the European Avocet *(Recurvirostra avocetta)*; *Docophorus pertusus* from *Fulica americana* (America), originally described from *Fulica atra* (Europe), and so on. In rare instances we find a bird-species common to both the Old World and the New World: certain birds of circumpolar range, as *Cepphus grylle*, and exceptional cases like that of *Puffinus major*, come in this category. The parasites of these birds will of course be common to America and to Europe. But such instances are rare. A few other cases may exist in which certain strong-flying maritime American and European or Asiatic birds may meet occasionally on some midoceanic island and a migration of parasites be effected. Such instances, also, are exceptional. The occurrence of a parasitic species common to European and American birds, which is not an infrequent matter (out of the sixty species of Mallophaga referred to in this paper as being taken on American birds one-third are referable to species previously described from European or Asiatic birds), must have another explanation than any yet suggested. This explanation, I believe, is, for many of the instances, that the parasitic species has persisted unchanged from the common ancestor of the two or more now distinct but closely allied bird-species. With the spreading of the ancestral bird-species, geographical races have arisen within the limits of the species which have, with time and isolation caused by newly appearing geographical barriers (due to geologic or climatic changes), come to be distinct species—species often distinguished only by superficial differences in color, etc. The parasites have remained practically unaffected by the conditions which have produced the differences among the birds; the temperature of the host's body, the feathers *as food*, all of the environment is essentially unchanged in its relation to the parasite. The parasitic species thus remains unchanged, while the first *Larus* species or *Anas* species becomes differentiated into a dozen or score of specific forms, all with a common parasite.

In substantiation of this explanation of a common possession of a parasitic species by Old and New World birds some examples may be referred to. As already mentioned, I have found on *Fulica americana* the same species of parasite, *Docophorus pertusus*, described by Nitzsch from specimens taken from the European *Fulica atra; Docophorus melanocephalus* taken by me on *Sterna maxima* is recorded by European authors from *Sterna caspia* and *S. cantiaca; Nirmus punctatus*, found by me on *Larus occidentalis* was described by Nitzsch from *Larus ridibundus* and has been found by Piaget on *Larus dominicans* from Chile and on *Larus ichthyætus* from the

Volgas; *Nirmus signatus* and *N. pileus* found by me on *Recurvirostra americana* were described by Piaget and Nitzsch respectively from *Recurvirostra avocetta*, the European Avocet; *Lipeurus ferox* taken by me on *Diomedea albatrus* is recorded by European writers from *Diomedea exulans*, *brachyura* and *melanophrys; Lipeurus forficulatus* taken by me on *Pelecanus erythrorhynchus* and *P. californicus* was described by Nitzsch from *P. onocrotalus;* and similarly the most of the twenty-two previously described species taken by me from American birds might be thus offered as examples. We have in all of these cases the common parasite occurring on the American representatives of the genus to which the original Old World host belongs. Looking now for the exceptions to this condition—namely, for instances where the known species when found on an American bird is found on one widely separated phyletically from the European host—we find no clearly defined instance of this condition, no instance where association during life or "straggling" after death of the host can be put aside as possible explanations of the presence of the parasite on the unexpected host.

There are to be noted other results of the influence on the taxonomy of the Mallophaga of the peculiar conditions of their parasitic life. While the uniformity and persistence of the conditions under which the life of the parasites is passed tends to preserve with little change the species types, the peculiar isolation, often pretty complete, of groups of individuals of a parasite species on individual birds of the host species and the consequent close breeding tend to foster and fix those inevitable slight variations always manifest in a comparison of offspring and parents, but under normal conditions held in check or lost (unless directly advantageous) by crossing among less closely related individuals. For example the individuals of a parasite species on a bird of long life and non-gregarious and monogamous habits, like an eagle, live very much the life of an isolated community. There must be many years of in-and-in breeding. It is like island life. The result is certain: the members of this isolated group will soon differ from the specific type in noticeable particulars. On the other hand, the conditions of life on this "island" are practically identical with the conditions on other similar "islands"—other eagles—inhabited by other individuals of the same parasite species, so there is no influence working to produce a wide divergence of the members of these various isolated groups of individuals of the same species. Now this isolation of groups of individuals is in some degree an incident of the life of all Mallophaga; in some instances it is considerable; in others, inconsiderable, but taken altogether a condition in the life of the whole order exerting an influence which has the readily recognizable result of creating a great number of small variations within species limits.

We have noted now two influences resulting from the peculiar habits of the Mallophaga which are somewhat opposed to each other. One influence, due to the uniform (as far as relation to parasite goes) conditions of the habitat, the body of the host, tending to preserve essentially unchanged the type-forms of the parasites; the other influence, due to the isolation of groups of individuals and the consequent close breeding, tending to foster and fix small variations. The results, manifest to any student of the group, are to render difficult the division of the order into distinct genera on account of the general similarity of structure, and to make difficult the definition of species on account of the many slight variations among the individuals from different bird individuals. While I believe myself able to refer specimens taken from American birds to a score of species described from specimens taken from European and Asiatic birds, in all of these instances there are slight but recognizable differences between the American specimens and the type-forms of the species (as well as I am able to make comparison, having only the drawings and descriptions of these type-forms to refer to).

The differences in relative abundance or rarity of the individuals of a species, and in the relative freedom or seriously infested condition of the hosts may be referred to briefly. Certain specific examples will serve to illustrate the various conditions. In the first place the host species may have several parasitic species as *Diomedea albatrus*, *Fulmarus glacialis* vars. *glupischa* and *rodgersii* and *Fulica americana*, each with six species of parasites; or the host species may have but one (very rarely) or two or three parasitic species infesting it, as with most of the ducks and gulls. A parasitic species may be constant in its appearance on the individuals of its host species, as *Docophorus lari*, almost certain to be found on any gull specimen shot, *Lipeurus celer*, which I found on twenty-nine out of thirty specimens of *Fulmarus glacialis* vars. *glupischa* and *rodgersii* examined, *Docophorus occidentalis* similarly found on twenty-nine out of these thirty Fulmars; or it may be found on but few individuals of the host species, as *Docophorus quadraticeps* found on one of fourteen specimens of *Fulica americana* examined, and *Nirmus præstans* found on two of fourteen specimens of *Sterna maxima* examined. There may be many individuals of a parasitic species always present on the body of the host, as with *Lipeurus celer* on the Fulmars, of which parasite I have collected nearly one hundred specimens from a single bird, and which is always abundantly present on its host; or the individuals may be few even though the parasite is a constant one, *i. e.*, almost always to be found on any specimen of the host examined. *Trinoton luridum* of the ducks is a good example of this constant presence in small numbers. There may be more than one species of the same genus of parasites on a single host, as *Lipeurus celer* and *Lipeurus varius*, both numerous on the Fulmars; but usually the different parasites of a host represent different genera, exemplified by the remaining four species of parasites of the Fulmars which belong to four other and different genera.

Finally, I may append to these desultory remarks concerning the distribution of the Mallophaga and the influence on their taxonomy of their peculiar habits of life a list of those bird hosts with their parasites, the examination of which has afforded the data for this paper. In preparing the list I have eliminated all instances of undoubted "straggling."

LIST OF HOSTS WITH PARASITES.

- Colymbus nigricollis californicus.
  - Docophorus lari.
  - kanseusis.
  - Menopon tridens var. insolens.
- Urinator pacificus.
  - Docophorus colymbinus.
  - graviceps.
  - Oncophorus advena.
  - Menopon tridens var. pacificum.
- Urinator lumme.
  - Docophorus colymbinus.
  - lari.
  - graviceps.
  - Nirmus farallonii.
- Ceratorhina monocerata.
  - Docophorus acutipectus.
- Ptychorhampus aleuticus.
  - Docophorus montereyi.
  - Menopon loomisii.
- Synthliborhampus antiquus.
  - Docophorus montereyi.
  - atricolor.
  - Menopon loomisii.
- Brachyrhampus marmoratus.
  - Docophorus montereyi.
  - atricolor.
- Uria troile californica.
  - Docophorus calvus.
- Rissa tridactyla pollicaris.
  - Docophorus lari.
- Larus glaucus.
  - Docophorus lari.
- Larus glaucescens.
  - Docophorus lari.
  - Nirmus lineolatus.
  - Colpocephalum funebre.
  - Menopon infrequens.

- Larus occidentalis.
  - Docophorus lari.
  - Nirmus lineolatus.
    - punctatus.
- Larus argentatus smithsonianus.
  - Docophorus lari.
  - Nirmus lineolatus.
- Larus vegæ.
  - Docophorus lari.
  - Nirmus lineolatus.
- Larus californicus.
  - Nirmus lineolatus.
- Larus delewarensis.
  - Docophorus lari.
  - Nirmus lineolatus.
    - punctatus.
- Larus brachyrhynchus.
  - Docophorus lari.
  - Nirmus lineolatus.
- Larus canus.
  - Docophorus lari.
  - Nirmus lineolatus.
- Larus heermanni.
  - Docophorus lari.
  - Nirmus lineolatus.
    - felix.
- Sterna maxima.
  - Docophorus melanocephalus.
  - Nirmus præstans.
    - hebes.
    - lineolatus.
- Sterna forsteri.
  - Menopon tridens var. insolens.
- Diomedea albatrus.
  - Nirmus giganticola.
  - Lipeurus ferox.
    - densus.
  - Eurymetopus taurus.
  - Colpocephalum pingue.
  - Menopon navigans.
- Fulmarus glacialis glupischa.
  - Docophorus occidentalis.
  - Lipeurus celer.
    - varius.
  - Eurymetopus taurus.
  - Ancistrona gigas.
  - Menopon numerosum.
- Fulmarus glacialis rodgersii.
  - Docophorus occidentalis.
  - Lipeurus celer.
    - varius.
  - Eurymetopus taurus.
  - Ancistrona gigas.
  - Menopon numerosum.
- Puffinus opisthomelas.
  - Lipeurus diversus.
    - limitatus.
    - testaceous.
  - Giebelia mirabilis.
- Puffinus griseus.
  - Lipeurus diversus.
    - limitatus.
  - Giebelia mirabilis.
- Phalacrocorax dilophus albociliatus.
  - Docophorus lari.
  - Nirmus farallonii.
  - Lipeurus toxoceras.
- Phalacrocorax penicillatus.
  - Nirmus farallonii.
- Pelecanus erythrorhynchus.
  - Lipeurus forficulatus.
  - Colpocephalum unciferum.
  - Menopon titan var. impar.
- Pelecanus californicus.
  - Docophorus lari.
  - Lipeurus forficulatus.
    - toxoceras.
  - Colopocephalum unciferum.
  - Menopon titan var. linearis.

- Merganser serrator.
  - Docophorus icterodes.
  - Lipeurus temporalis.
    - squalidus.
- Merganser americanus.
  - Lipeurus squalidus.
  - Trinoton luridum.
    - lituratum.
- Anas boscas.
  - Docophorus icterodes.
  - Trinoton luridum.
    - lituratum.
- Anas americana.
  - Trinoton luridum.
- Anas carolinensis.
  - Trinoton luridum.
- Spatula clypeata.
  - Trinoton luridum.
- Dafila acuta.
  - Docophorus icterodes.
  - Trinoton luridum.
    - lituratum (?)
- Aythya americana.
  - Docophorus icterodes.
- Aythya affinis.
  - Docophorus icterodes.
- Charitonetta albeola.
  - Lipeurus squalidus.
- Oidemia deglandi.
  - Docophorus icterodes.
- Oidemia perspicillata.
  - Docophorus icterodes.
  - Lipeurus constrictus.
- Erismatura rubida.
  - Docophorus icterodes.
    - pertusus.
  - Trinoton luridum.
- Ardea egretta.
  - Colpocephalum laticeps.
- Fulica americana.
  - Docophorus pertusus.
  - Lipeurus picturatus.
    - longipilus.
  - Oncophorus advena.
  - Laemobothrium atrum.
  - Menopon tridens var. pacificum.
- Recurvirostra americana.
  - Nirmus signatus.
    - pileus.
  - Colpocephalum uniforme.
  - Menopon indistinctum.
- Charadrius squatarola.
  - Docophorus fuliginosus.
- Charadrius dominicus.
  - Nirmus orarius.
  - Colpocephalum timidum.

POSITION AMONG INSECTS.

What the position of the Mallophaga among insects is, is still a moot question, as indeed, strictly speaking, is the position of any one of the groups. The Mallophaga by reason of their habits have been constantly associated in entomological literature with the Pediculidæ. It is hardly worth while here to trace the Mallophaga in their tortuous path through the various schemes of insect classification from the times of Redi to the present day. It has not been until comparatively recent years that the facts of structure and life history upon which the classification of any group depends were known in the case of the Mallophaga. The classificatory attempts prior to that time were simply the results of conjecture.

Grouped for a long time with the Hemiptera, because the Mallophaga are, what the Pediculidæ, undoubted Hemiptera, are, external parasites of animals, the testimony of the biting mouthparts finally effected their removal to that heterogeneous group of insects, the order Pseudo-Neuroptera. Here they came to be associated, in all of these steps more and more nearly approximating the truth, with the Termites, Psocids, Perlids and Embids, these groups forming the suborder Platyptera. Dr. Brauer in 1885 broke up the order Pseudo-Neuroptera, and after this cataclysm our Mallophaga found themselves in company with the Termites and Psocids constituting the order Corrodentia. Finally under the impetus thus acquired in order-breaking many entomologists have gone further, and in the hands of these men the Mallophaga reach the standing of an independent order. The latest American text-book of entomology, Comstock's Manual of Insects, 1895, adopts this treatment of the group.

Whether a group of insects should be called an order or a suborder or what not is largely, of course, a matter of an author's attitude in matters classificatory. The point manifest in all this shifting about and gradual growth of ranking importance of the Mallophaga is that the group is one well removed from any other group of insects. The more the structure and life history of the bird-lice have been studied, the more difficult it has become to ally them closely with any other insects. The, at first glance, apparently simple and lowly structure of them is discovered by study to be the result of a specialization along the lines of parasitism. The simplicity of outer habitus, lack of wings, the rather Thysanuriform appearance are not the simplicity of a generalized, of a racial condition, but of a specialization, albeit in the line of reduction or degradation. With the simple general structure there goes a highly concentrated nervous system, greatly modified mouth parts, and curiously specialized antennæ.

The thorough study of the life-history, embryonic and postembryonic, is needed to throw more light on the position of the Mallophaga. Till such study is made, the present isolated position assigned the group, based on the known structure of the adult and on its habits, may be accepted as representing the consensus of authority.

CLASSIFICATION.

The Mallophaga were divided by Nitzsch into two families, the Philopteridæ, with filiform antennæ and without maxillary palpi, and the Liotheidæ, with capitate 4-segmented antennæ and maxillary palpi. The family Philopteridæ included two genera, *Trichodectes*, with 3-segmented antennæ and 1-clawed tarsi, and *Philopterus*, with 5-segmented antennæ and 2-clawed tarsi. The latter genus was subdivided into the five subgenera, *Docophorus*, *Nirmus*, *Goniocotes*, *Goniodes*, *Lipeurus*. The family *Liotheidæ* similarly included two genera, *Gyropus*, with 1-clawed tarsi, and *Liotheum*, with 2-clawed tarsi. The latter genus was subdivided into six subgenera, *Eureum*, *Læmobothrium*, *Physostomum*, *Trinoton*, *Colpocephalum* and *Menopon*. The two 1-clawed genera *Trichodectes* and *Gyropus* were found by Nitzsch exclusively upon mammals; all the other genera exclusively upon birds.

In essential identity the classification of to-day is that of Nitzsch; it differs in discarding the generic groups *Philopterus* and *Liotheum*, and in considering the Nitzschian subgenera as genera, and in the addition of several new genera.

That change by which the one-time subgenera of *Philopterus* are now put on equality with the genus *Trichodectes*, and similarly the subgenera of *Liotheum* on equality with *Gyropus*, seems to me ill-advised. The two genera found on mammals differ so radically and in so many ways from their related genera in each family that I believe their striking host and structural differences should be emphasized in the classification. I propose, therefore, in the light of the present position of the Mallophaga as an independent order of insects, to rank the Nitzschian families as suborders, and the Nitzschian genera as families, and the Nitzschian subgenera, the genera of present day writers, as genera. This will leave unchanged the present generic names and ranking, but will restore the expression, first indicated by Nitzsch in his generic rankings, of differences between the mammalian parasites and the avian parasites. This re-ranking, which is practically a return to classification of Nitzsch, finds expression in the keys and synopses which I have arranged to receive all of the genera so far recognized.

Although the Mallophaga include already nearly 1000 described species there are but few genera and these genera are difficult to separate. In other words, the whole group is a series of closely related and intergrading forms. The causes and conditions of this state of affairs I have already attempted to explain in the paragraphs under the head of "Distribution" *(antea)*. In this place the facts of this close inter-relation come home to us in the attempt to arrange keys for the separation of the genera. I found trouble, when beginning the study of the Mallophaga, in distinguishing by the published keys certain genera; whether a Philopterid parasite was a *Docophorus* or a *Nirmus*, or whether a Liotheid parasite was a *Menopon* or a *Colpocephalum*, were questions not definitely answered by the key. In introducing into the key the genera which have been described since the making of the key used in the European monographs, I find naturally increasing difficulties; so I have accompanied the key with a synopsis of all of the described genera, calling attention to the characters which go to give any genus its peculiarly characteristic appearance. With the key and the diagnosis I hope that any genus can be satisfactorily determined. For definitions of the terms used in referring to various structures of the Mallophaga, see the Terminology, following the synopsis.

KEY TO THE SUBORDERS.

A. With filiform 3- or 5-segmented antennæ, and no labial palpi. Suborder ISCHNOCERA.

AA. With clavate or capitate 4-segmented antennæ, and 4-segmented labial palpi. Suborder AMBLYCERA.

KEY TO THE GENERA OF THE SUBORDER ISCHNOCERA.

- A. With 3-segmented antennæ; tarsi with 1 claw; infesting mammals (family Trichodectidæ). TRICHODECTES N.
- AA. With 5-segmented antennæ; tarsi with 2 claws; infesting birds (family Philopteridæ).
  - B. Antennæ similar in both sexes.
    - C. Front deeply angularly notched. AKIDOPROCTUS P.
    - CC. Front convex, truncate, or rarely with a curving emargination, but never angularly notched.
      - D. Species broad and short, with large movable trabeculæ (at the anterior angle of antennary fossa).
        - E. Forehead with a broad transverse membranous flap projecting beyond lateral margins of the head in the male, barely projecting in female. GIEBELIA Kellogg.
        - EE. Without such membranous flap. DOCOPHORUS N.
      - DD. Species elongate, narrow; with very small or no trabeculæ. NIRMUS N.
  - BB. Antennæ differing in the two sexes.
    - C. Species wide, with body elongate-ovate to sub-orbicular.
      - D. Temporal margins rounded; last segment of abdomen roundly emarginated; antennæ of male without appendage, third segment very long. EURYMETOPUS Tasch.

DD. Temporal margins usually angulated; last segment of abdomen convex, rarely angularly emarginated with two points.
  E. First segment of antenna of male large, sometimes with an appendage; third segment always with an appendage. **Goniodes** N.
  EE. First segment of antenna of male enlarged, but always without appendage; third segment without appendage; last segment of abdomen always rounded behind. **Goniocotes** N.

CC. Species elongate, narrow, sides sub-parallel.
  D. Third segment of antenna of male without an appendage. **Ornithobius** Denny.
  DD. Third segment of antenna of male with an appendage.
    E. Front deeply angularly notched. **Bothriometopus** Tasch.
    EE. Front not angularly notched.
      F. Antennæ and legs long; a semicircular oral fossa. **Lipeurus** N.
      FF. Antennæ and legs short; oral fossa narrow, elongate, extending as a furrow to the anterior margin of the head. **Oncophorus** Rudow.

KEY TO THE GENERA OF THE SUBORDER AMBLYCERA.

A. Tarsi with 1 claw; infesting mammals (family Gyropidæ). **Gyropus** N.

AA. Tarsi with 2 claws; infesting birds (except *Boopia?*) (Family Liotheidæ.)
  B. Ocular emargination distinct, more or less deep.
    C. Forehead rounded, without lateral swelling; antennæ projecting beyond border of the head. **Colpocephalum** N.
    CC. Forehead with strong lateral swellings.
      D. Antennæ projecting beyond border of the head; temporal angles projecting rectangularly; eye large and simple. **Boopia** P.
      DD. Antennæ concealed in groove on under side of the head; temporal angles rounded, or slightly angular; eye divided by an emargination and fleck.
        E. Mesothorax separated from metathorax by a suture. **Trinoton** N.
        EE. Meso- and metathorax fused; no suture. **Læmobothrium** N.
  BB. Ocular emargination absent or very slight.
    C. Sides of the head straight or slightly concave, with two small laterally-projecting labral lobes. **Physostomum** N.

CC. Sides of the head sinuous; forehead without labral lobes.
  D. Body very broad; metathorax shorter than prothorax. EUREUM N.
  DD. Body elongate; prothorax shorter than metathorax.
    E. Ocular emargination filled by a strong swelling; sternal markings forming a quadrilateral without median blotches. NITZSCHIA Denny.
    EE. Ocular emargination without swelling, hardly apparent or entirely lacking; median blotches on sternum.
      F. Very large; with two 2-pointed appendages on ventral aspect of hind-head; anterior coxæ with very long lobe-like appendages. ANCISTRONA Westwood.
      FF. Small or medium; without bi-partite appendages of hind-head. MENOPON N.

SYNOPSIS OF MALLOPHAGA.

Suborder ISCHNOCERA.

With the antennæ filiform, 3- to 5-segmented, sometimes differing in the sexes; no labial palpi.

Family TRICHODECTIDÆ.

Characters of the single genus.

Genus *Trichodectes*. Infesting mammals; tarsi with one claw; antennæ 3-segmented, in some species differing in the sexes; legs thickly beset with hairs; female with a pair of bent appendages on the sides or ventral surface of the eighth abdominal segment.

Family PHILOPTERIDÆ.

Infesting birds; tarsi with two claws; antennæ 5-segmented, not lying in an excavation on the under side of the head, but always projecting far beyond the sides of the head.

Genus *Docophorus* Nitzsch. (Plates iii and iv.) Body short and broad, head usually as wide across the temples as long, front broadly truncate or convex or slightly concave, rarely with a curving emargination; clypeus with distinct suture, often with a broad uncolored anterior and lateral margin; signature usually shield-shaped, with acuminate posterior angle; prominent movable trabeculæ reaching to or beyond end of the first antennal segment; antennæ similar in the sexes, with thick first segment, segment 2 the largest, and segments 3–5 subequal. Thorax with meso- and meta-segments completely coalesced; legs rather flattened, insertions approached; front legs smallest and usually concealed beneath the head. Abdomen usually oval, of nine segments of about equal length; last segment of male rounded, of female small and emarginated. Color and markings whitish on buffy ground, markings clear light brown to opaque dark brown, and even to black; head with antennal occipital bands; thorax with lateral borders; abdomen with lateral bands, darkest, and lateral transverse blotches, longest in male where they nearly meet on the median line. This genus has been found on birds of all the larger groups except the Gallinæ.

Genus *Giebelia* Kellogg. (Plate xi.) General characters of *Docophorus;* forehead (labrum?) with a broad transparent membranous flap extending across the ventral surface of head and projecting conspicuously beyond lateral margins of head in the male and but slightly in the female; rectangular anterior angles of temporal region with large eye in the angle. Found, as yet, only on the genus *Puffinus* (Shearwaters).

Genus *Nirmus* Nitzsch. (Plates v and vi.) Body usually narrow and elongate, though not actually long, the species rarely exceeding 3½ mm. in length; the antennæ similar in the sexes; clypeal suture ordinarily indistinct; the trabeculæ wanting, or if present very small, inconspicuous and not movable (rarely large and feebly movable); other characters approximately those of *Docophorus.* Found on all kinds of birds.

Genus *Akidoproctus* Piaget. Body slender, elongate, Nirmoid in general shape; front of clypeus with a deep median rectangular notch, clypeal suture not distinct; antennæ similar in the sexes, situated distinctly before the middle of the head, short; prothorax rectangular, meso- and metathorax fused, widest (except in one species) in front; abdomen with broad sutures and a longitudinal median uncolored line; slightly mesad of the lateral band there runs parallel with it on each side a second narrow transparent lateral band; the two last segments in both sexes abruptly narrower than the seventh and conical. But four species belonging to this genus have been described.

Genus *Eurymetopus* Taschenberg. (Plate xi.) Body broad, *Docophorus*-like; antennæ differing in the sexes; clypeus broad, truncate; anterior angles of antennary fossæ produced and pointed; metathorax short, broad, without indication of constriction between meso- and meta-segments; coxæ not projecting beyond lateral margins of thorax; posterior segment of abdomen broadly round with slight rounding emargination, deeper in female than in male. But three species of this genus are yet known, of which one is so aberrant that it should probably be made the type of a new genus.

Genus *Goniodes* Nitzsch. Body large and broad; head usually with temporal margin and outer occipital margin angulated; head often varying in form in the sexes; antennæ differing in the sexes, third segment of male always with appendage, first segment enlarged and sometimes with appendage; prothorax usually trapeziform, metathorax much larger, rounded laterally; abdomen usually broadly oval, lateral band broad. Color usually whitish or pale yellowish, the blotches tawny, the bands dark brown to black. Found only on Gallinaceous birds.

Taschenberg has given sub-generic names to certain pretty distinctly separable groups of species. These subgenera may be distinguished by the following table:

A. With rounded temporal and occipital corners. No appendage on third segment of male, or a very small one. ***Stronglyocotes.***

AA. With angulated temporal and occipital corners.

- **B. Antenna of male with segments 4 and 5 very short, third segment with appendage. Temporal angles weak.** ***Coloceras.***
- **BB. Segments 4 and 5 of male antenna of ordinary size. Temporal angles distinct.**
  - **C. Segment 3 of male antenna with appendage; segment 1 long and thick and sometimes with appendage.** ***Goniodes s. str.***
  - **CC. Segment 3 of male antenna without appendage (distal angle slightly produced); segment 1 without appendage.** ***Rhopaloceras.***

Genus *Goniocotes* Burmeister. General characters those of *Goniodes*, but usually smaller species, and with antennæ of male never appendaged; the antennæ differ but little in the sexes, the male sometimes having the first and second segments larger than in the female. The species of this genus are found on gallinaceous and columbine birds.

Genus *Ornithobius* Denny. Body elongate, narrow; head broad, rather quadrangular; clypeus with a frontal emargination expanded within so that the bounding sides are pincer-like in shape, the points almost meeting, thus nearly inclosing the emargination; the antennæ arise far in front of the middle of the head, and differ in the sexes; the antennæ of the male have the first two segments larger than the others, and the third, which is diagonally truncated and expanded distally, is with or without an appendage; the abdomen has two parallel lateral bands on each side, and the last segment of the male is pointed, of the female rounded or truncate. Only three species of this genus have been found, all on swans.

Genus *Bothriometopus* Taschenberg. Body elongate, sides subparallel; head about as long as wide, with swelling rounded temples; clypeus including most of the forehead; without antennal bands, and with a deep angular frontal emargination or notch (much as in *Akidoproctus);* antennæ situated in front of middle of head and differing in the sexes; the antenna of male long, first segment thickened and as large as all the others together and with a pointed projecting process; antenna of female short, first two segments of equal length; legs very long, abdomen of both sexes with posterior segment 2-pointed behind. But one species has been described, taken from *Palamedea.*

Genus *Lipeurus* Nitzsch. (Plates vii, viii, ix and x.) Body long, slender; head usually narrow, elongate, with rounded temporal margins; clypeus usually with distinct signature, and with distinct or indistinct suture; antennæ differing in the sexes, the male antenna with first segment long and thick, rarely with appendage; third segment has an appendage, which is sometimes small and inconspicuous; the female antenna is simply filiform with first segment the thickest and second segment the longest; metathorax usually at least twice as long as the prothorax, often showing a lateral constriction indicating the line of fusion of meso- and meta-segments; the legs arise far apart, the proximity of the coxal cavities of the second and third pairs of legs to the thoracic margins being one of the diagnostic characters of the genus; the coxæ are long and project conspicuously beyond the lateral margins of the thorax; abdomen elongate and narrow, with segments 8 and 9 fused. Body color, white to brown, with conspicuous markings of pale brown to black. There are many described species and they have been found on all kinds of birds, being especially common on swimmers and rare on passerine birds.

Genus *Oncophorus* Rudow. (Plate xi.) (The generic name *Oncophorus* was proposed by Rudow for a species which has since been transferred to another genus, *Eurymetopus*, but Piaget, retaining the generic name, has grouped under it a number of species presenting the characters following. This genus "*sert de transition naturelle entre les genres Docophorus et Nirmus d'une part et les genres Goniodes et Lipeurus d'autre part.*") Usually small, 2 mm. being a maximum length among the known species; varying from broad to slender; head conical, clypeus with or without distinct suture, with or without signature; antennæ differing in the sexes, the male antenna longest, and the first three segments with or without appendages; prothorax but little shorter than the metathorax; legs short like those of *Nirmus;* color generally dark brown. But few species (eleven) so far described.

Suborder AMBLYCERA.

With the antennæ clavate or capitate, 4-segmented, and with filiform 4-segmented labial palpi.

Family GYROPIDÆ.

Characters of single genus.

Genus *Gyropus* Nitzsch. Infesting mammals, tarsi with one claw; temples produced into angulated processes; mouth parts on the frontal margin of the head; size, small from .7 to 1.2 mm.

Family LIOTHEIDÆ.

Infesting birds (see *Boopia!);* tarsi with two claws; the 4-segmented antennæ lying, when not outstretched, in an excavation on the under side of the head.

Genus *Colpocephalum* Nitzsch. (Plate xii.) Body varying in size from very small (1 mm.) to large (3 mm.), elongate, oval or elliptical; head usually wider than long with distinct ocular emargination; eye located in the posterior portion of the emargination, simple or semi-divided by an emargination; temples usually swollen or "winged" with rounded or nearly straight lateral margin; just behind the eye and along the anterior margin of the temple a series of fine short hairs, the "ocular fringe"; the 4-segmented labial palpi extending beyond the lateral margins of the head; the 4-segmented antennæ with first segment short, cylindrical, second, conical, truncated, third goblet-shaped, fourth cylindrical or ovoid usually obliquely truncated; prothorax usually longer than metathorax, with produced lateral angles and bearing a pale or uncolored transverse line which does not extend into the lateral angular regions; mesothorax indicated by a slight constriction and sometimes by an uncolored transverse line across the metathoracic segment; first segment of tarsus short, with a small flat lobe or plate, second very long and slender; abdomen with nine segments, the posterior one differing in the sexes, with distinct dorsal and ventral posterior borders. Color whitish or yellowish with pale to dark brown markings. The genus contains many species, found on all birds except ostriches.

Genus *Boopia* Piaget. The single species upon which this genus is established by Piaget was found by him in company with individuals of *Colpocephalum truncatum* on *Phascolomys fossor*, a wombat! Can these true Liotheid forms have been stragglers from some bird host to this mammalian host? The characters of the genus, as shown by the one species, are: Body about 2 mm. long; head rounded in front, ocular emargination wide but shallow, situated more anteriorly than in other Liotheidæ; eye hemispherical, very large, located in the anterior portion of the ocular emargination; temples angularly produced; the palpi passing the margins of the head by three segments; the antennæ with second segment subspherical, third pedunculated, fourth the largest; thorax much as in *Colpocephalum;* legs, long and hairy; abdomen of eight (?) segments. The middle of the head and borders of the abdomen yellowish; the rest of the head, thorax and abdominal blotches tawny.

Genus *Trinoton* Nitzsch. (Plate xiii.) Body large, from 2 to 6 mm. long; head, triangular, with rounding angles, with projecting rounded temples, and convex arcuated occipital margin; antennæ, short and concealed, palpi projecting beyond lateral margins of forehead; eye prominent and emarginated, appearing double; the whole thorax very long, in one species larger than the abdomen; mesothorax separated from metathorax by distinct suture (the diagnostic character of the genus); legs long, strong and haired; first segment of tarsus short, with two narrow and acute lobes, second long with two small lobes near the extremity; abdomen elongate oval, nine segments, the posterior segment being rounded behind in the female and trilobed in the male. Color whitish, with brown or reddish brown blotches and black bands.

Genus *Læmobothrium* Nitzsch. (Plate xiv.) Large species, from 5 to 10 mm. long; body elongate, rather slender; head usually longer than wide, truncate or emarginate in front; temples but little swollen with occipital corners angulated; occipital margin deeply concave, with a neck-like prolongation; a large and distinct oral fossa; the mesothoracic suture obsolete, although usually faintly indicated; metathorax separated from abdomen by distinct suture, but of general appearance of an abdominal segment; legs long and strong; first segment of tarsus short with a large lobe; second segment very long and without lobes; abdomen elongate, tapering posteriorly; the ninth segment rounded or truncate. Color varying from tawny to blackish brown on a whitish ground. Found on birds of prey, and certain water birds.

Genus *Physostomum* Nitzsch. Species large, from 2½ to 5 mm. long; body elongate; head broadly conical, straight or a little concave on the lateral margins, without ocular emarginations; broad and usually truncate or flatly convex in front; temporal corners angulated; the under side of the forehead with two small motile muscular lobes projecting slightly beyond the lateral margins, characteristic marks of the genus; palpi prominent; antennæ very short, always concealed in their furrows; thorax longer than the long head; meso- and metathorax completely fused, the posterior width of the metathorax same as anterior width of first segment of abdomen; legs robust, little colored and with few hairs; first segment of tarsus with a small double lobe; second segment rather short. Abdomen elongate elliptical, ninth segment broad and rounded. Color clear pale brown to yellowish, abdomen with lateral bands. The species are few and have been found as yet exclusively on passerine birds.

Genus *Eureum* Nitzsch. Body large, head and abdomen very wide, and metathorax very short; head without ocular emargination and with temples very much enlarged and rounded; antennæ concealed in their cavities; the palpi never projecting beyond lateral margins of the head; thorax about same length as the head; prothorax concave before and behind; the shorter metathorax of the same form as first segment of abdomen; legs long, second segment of tarsus very long; abdomen with acute posterior angles of segments, and hairy. But two species are known, one found on a swallow and the other on the chimney swift.

Genus *Nitzschia* Denny. Body of medium size, about 2 mm. long; head with small ocular emargination, and a slight but distinct emargination of the lateral margin in front of the ocular emargination, being about where the projecting palpi pass the margins of the head; head wider than long, temples expanded and angulated in front and behind; antennæ short and entirely concealed in their cavities; palpi rather long and projecting beyond margins of the head; prothorax hexagonal with obtuse angles; the mesothoracic suture slightly indicated on the lateral margins; legs long and only slightly colored, first tarsal segment very short with a small acute lobe, second segment larger; abdomen similar in the sexes, obovate, widening posteriorly, with broad lateral bands. Color tawny, blotches ferrugineous, and lateral bands dark reddish brown. Only one species certainly known; found only on the chimney swift.

Genus *Ancistrona* Westwood. (Plate xiii.) Body very large, 6 mm. long and 2½ mm. wide; head crescentic, without ocular emargination; with two 2-pointed strongly-chitinized processes on ventral aspect of hind head projecting backward beyond occipital margin of the head; antennæ concealed in ventral cavities; the lateral palpi short. Prothorax as large as the head; the metathorax like an abdominal segment; the coxæ of the front legs bear a long appendage or lobe; abdomen of ten segments. Only a single species certainly known; found on the Fulmars.

Genus *Menopon* Nitzsch. (Plates xiv and xv.) Body small to large, varying from 1 mm. to 5 mm. in length; of general shape and character of *Colpocephalum* (from which it is sometimes hardly distinguishable), but the ocular emargination is wanting or is slight; an ocular emargination is often present and plainly visible inferiorly, but superiorly there is a membrane which extends across it; head always widest across the temples; the antennæ short, first two segments truncated, conical, the second rarely with a short appendage, the third usually pedicellated and goblet-shaped, receiving the spherical or ovoid or cylindrical fourth into this open mouth; the fourth is always the largest of the four segments; mesothorax fused with metathorax; legs long, first segment of tarsus very short with a lobe of variable form, second long with a small chitin plate often swollen at its extremity; abdomen differs in the sexes, both as to general form and specially as to the last (ninth) segment; posterior border of ninth segment of female fringed with fine hairs which are not present in male. Color whitish or yellowish with darker markings. This is a very large genus, infesting all kinds of birds.

TERMINOLOGY.

By means of the following definitions and accompanying figures the student will be enabled to understand, it is hoped, the special descriptive and structural terms used in the synopses, keys and descriptions of Mallophaga. Most of these terms are the English equivalents, as nearly as possible, of the terms used in the French and German monographs. A few of them are here first used.

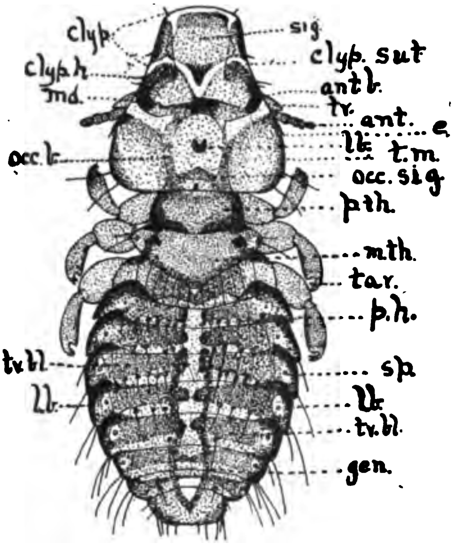


Fig. 1. *Docophorus fuliginosus* Kell., male; *clyp.*, clypeus; *clyp. sut.*, clypeal suture; *clyp. h.*, clypeal hair; *sig.*, signature; *md.*, mandibles; *ant.*, antenna; *tr.*, trabecula; *e.*, eye; *occ. b.*, occipital band; *ant. b.*, antennal band; *lb.*, chitinized part of labium; *occ.sig.*, occipital signature; *pth*, prothorax; *mth.*, metathorax; *tar.*, tarsus; *p. h.*, "pustulated" hairs; *tr. bl.*, transverse blotch; *l. b.*, lateral band; *sp*, spiracle; *gen.*, genitalia.

Antennal Appendage (fig. 2). A projecting process on the first or third segments of the antennæ of the males of certain genera. This appendage may be simply a slight projection of one side of the distal extremity of the segment, or may be long and curving, and may arise from the middle of the segment.

Antennal Bands (*ant.b.*, fig. 1). Pale to dark-colored chitinous bands extending along the lateral margins of the forehead, interrupted and divided into two parts when the clypeal suture is distinct, sometimes divided into three parts (*Nirmi nigro-picti*).

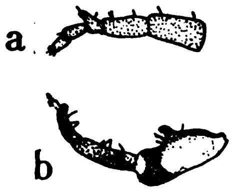


Fig. 2. *a*, antenna of *Lipeurus baculus* ♂; *b*, antenna of *Lipeurus ferox* ♂.

Antennary Furrows (*ant. f.*, fig. 3). The furrows on ventral aspect of head of members of the Liotheidæ in which the antennæ lie, concealed from dorsal view.

Clypeal Hairs (*clyp. h.*, fig. 1). Usually short, fine hairs on the margins, frontal and lateral, of the clypeus.

Clypeus (*clyp.*, fig. 1). That part of the head in front of the clypeal suture; prominent throughout the group.

Clypeal Suture, or, in descriptions of the head, the *suture* (*clyp. sut.*, fig. 1). The distinct or indistinct suture separating the clypeus from the rest of the head; when distinct, appearing as a narrow uncolored line; when indistinct, usually recognizable on the lateral margins of the head by a small emargination.

Forehead That part of the head in front of the mandibles and antennæ.

Genital Blotch. Abdominal markings on the under side of the last segments of the female; sometimes single and median, sometimes paired and lateral.

Genitalia (*gen.*, fig. 1). The colored chitinized parts of the genitalia, often showing through the surface of the body.

Hind-head. That part of the head behind the mandibles and antennæ.

Inter-coxal Line (*i. c. l.*, fig. 4). A sternal marking consisting of a colored line or narrow band running transversely between two coxæ of the same side.

Lateral Bands (*l. b.*, fig. 1). The dark or transparent lateral margins of the abdomen.

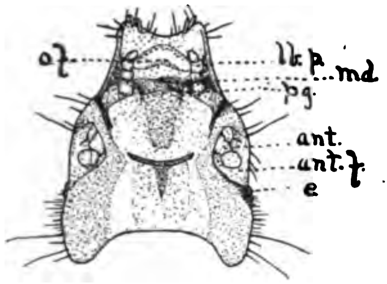


Fig. 3. Under side of head of *Læmobothrium similis* Kell.; *o.f.*, oral fossa; *lb.p.*, labial palpus; *md.*, mandible; *pg.*, paraglossa; *ant.*, antenna; *ant.f.*, antennary furrow; *e.*, eye.

Labial Palpi (*lb. p.*, fig. 3). The 4-segmented labial palpi, present only among the Liotheidæ; usually projecting laterally beyond the lateral margins of the forehead.

Metathorax (*m. th.*, fig. 1). As the meso- and metathorax are in most genera of the order fused into a single segment; the term metathorax used when no mention is made of the meso-thorax is intended to apply to this compound segment.

Occipital Bands (*occ. b.*, fig. 1). Pale to dark-colored chitinous bands extending from the occipital margin forward to the mandibular rami.

Occipital Margin. The posterior margin of the head.

Ocular Bands. Bands extending from the eyes to the anterior extremities of the occipital bands.

Ocular Blotch. A colored blotch contiguous to the inner margin of the eye.

Ocular Emargination. An emargination of the lateral margin of the head, the eye lying in the emargination though near the posterior end of it.

Ocular Fleck. A small intensely black spot of pigment in the eye.

Oral Fossa (*o.f.*, fig. 3). A furrow lying in front of the mandibles.

Ocular Fringe. A series of closely set small hairs on the posterior half of the inner margin of the ocular emargination and extending to and sometimes on the temporal margin; especially characteristic of *Menopon* and *Colpocephalum*.

Pustulated Hairs (*p. h.* fig. 1). Hairs rising from uncolored (unchitinized) spaces.

Signature (*sig.*, fig. 1). A colored blotch on the clypeus, usually with a posterior acuminate point. The *occipital signature* is a usually subcircular colored blotch on the under surface of the hind-head, often showing through above.

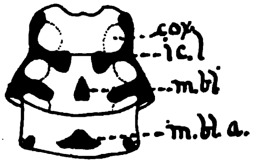


Fig. 4. Ventral aspect of thorax and first abdominal segment of *Nirmus præstans* Kell.; *cox.*, coxa; *i. c. l.*, intercoxal line; *m. bl.*, median sternal blotch; *m bl. a.*, median blotch of abdominal segments.

Sternal Markings (fig. 4). Colored blotches and lines on the ventral aspect of the thorax.

Temporal Margins (*t. m.*, fig. 1). The lateral margins of the hind-head.

Trabeculæ (*tr.*, fig. 1). Two processes, one on each side of the head, projecting laterally from the anterior angle of the antennary fossa; largest and movable in *Docophorus*.

Transverse Blotches (*tv. bl.*, fig. 1). The colored blotches, one on each lateral half of each abdominal segment.

Collections Made.

The specimens which I have had for study have been collected by me from newly-killed birds, or from freshly-made skins under the following circumstances:

(a) A collection made at Lawrence, Kansas, during the years 1889–1892, exclusively from newly-killed birds, the birds determined by me, and in most cases collected by me.

(b) A collection made by me at the Hopkins Seaside Laboratory on the shore of the Bay of Monterey, California, during the two weeks from Dec. 17, 1894, to Jan. 1, 1895, from newly-killed birds and from the fresh skins lying in cotton forms on tables in the laboratory; the birds were collected on the bay by Mr. Leverett M. Loomis, Curator of Birds of the California Academy of Sciences, and were determined by him.

It will always be of interest to the student of these parasites to know the exact conditions attending the collection of any set of specimens in order that he may weigh fairly the probable accuracy of the host determinations and the value of any statements as to relative abundance of the individuals of a species, or of the constant or casual occurrence of any parasite species on the individuals of its host species.

A large number of the specimens upon which the monographs of the order are based were collected from the dried skins of birds in various museums. Piaget has found the museum of Leyden a fertile field for collecting. But it is evident that collecting under such circumstances makes uncertain any generalization regarding the abundance of individuals on the host, and the constancy of occurrence of any certain parasite species on any certain bird species. There is also much likelihood of "straggling" and little opportunity to prove or disprove it. On the other hand, in collecting from the newly-killed birds one can practically determine the total parasitic fauna of any bird specimen; and, where a large series of specimens of one bird species is obtained, definite conclusions as to the constant or casual occurrence of a parasite species upon its host can be attained. The collection of immature specimens is practically restricted to collectors from newly-killed specimens because the tender, unchitinized body of the young insect shrivels soon after death; thus the immature insects are rarely found on dried skins. This may account for the absence of references in the European monographs to the immature stages of any of the described species.

METHODS OF COLLECTING AND PRESERVING.

The methods of collecting are simple. The parasites do not leave the body quickly after the death of the host, so if there is no opportunity to take them from the host in the field immediately after shooting, they may be collected after the dead birds are brought to the laboratory or museum. Most of my collecting has been done in connection with the collection of the birds for museum purposes. The parasites frequent all parts of the body of the host, but after death of the host are especially to be sought about the lores and base of the bill. Here they seem to congregate, and while sometime after death of the host many parasites leave the body others will stop their traveling at the base of the bill, and rather than leave the body will fasten themselves by claws or mandibles to the short stiff feathers of this region and die there. The death of the parasites which remain on the body after death of the host takes place in from four or five hours to seven days. In most cases all of the parasites are dead at the end of two or three days. It is evident, in face of the fact that after death of host many parasites leave the body, that much care must be taken to prevent "straggling," i. e., parasites from one bird getting upon some other bird which may be conveniently near. In the game-bag each bird should be well wrapped in paper, or, as is common with collectors, placed in a paper cone head downwards.

In addition to the examination of newly-killed birds, the examination of freshly-made skins may be made, or even of old and dry skins. On these skins the dried bodies of the dead insects, their external appearance (in case of adults) little modified because of their firm chitinous covering, may be found attached by the mandibles to the feathers.

The collected insects should be kept in alcohol in vials. I put all of the parasites taken from one bird specimen in a single vial, giving this vial an accessions number and putting into it a label bearing name of locality, date and name of bird. Later, with opportunity, the specimens in any one vial may be assorted into species putting each species in a vial by itself and giving this vial the same accessions number as the original vial and in addition a sub-number or letter. In my catalogue of accessions there are entered under each accessions number the sub-numbers or letters with specific name of the parasites when determined. By this plan, any specimen of parasite can be traced at any time to the individual bird from which it came, and statistics of abundance on the host, of number of individuals of a single species, or of the constant or casual occurrence of a parasite species on a host species can be compiled. Also, the parasitic faunæ of different specimens of the same bird-species from different localities can be critically compared.

The alcohol modifies the specimens but little; their hard chitin covering prevents appreciable shrinking, and the colors are due chiefly to the excess or scantiness of chitinization in different parts of the body, a coloration not much affected by alcohol. Specimens intended for dissection can be well preserved in soft condition in a five per cent. solution of chloral hydrate.

DESCRIPTIONS OF NEW SPECIES.

Docophorus calvus n. sp. (Plate iii, fig. 1.)

A single female, taken on a California Murre, *Uria troile californica* (Bay of Monterey, California).

Description of female. Body, length 1.7 mm., width .8 mm.; short, broad, small, with golden brown markings, darker on margins, almost without hairs.

Head, length .53 mm., width .56 mm., thus being slightly wider than long; conical, with uncolored frontal part of clypeus slightly expanded and feebly emarginate; suture distinct; lateral margin of head in front of suture slightly concave; temporal margins convex with two hairs, and one hair in the prominent eye; occipital margin straight; trabeculæ large; signature colored, posterior margin with darker-colored acuminate point, anterior margin parallel with front margin of clypeus, i. e., emarginate; antennal bands distinctly colored and continued in front of suture, and bending in at posterior ends; behind these bent-in ends a diagonally transverse, uncolored line; occipital bands distinct; temporal margins colored.

Prothorax small, short, much narrower than the head; angled behind, with a slight, rounding prominence at posterior lateral angles bearing a single hair; colored, paler in the center. Metathorax short, angled behind, with sides produced and obtusely rounded, bearing one long hair; whole segment strongly colored.

Abdomen broadly elliptical; first segment wholly colored, segments 2–7 with a strong lateral blotch, irregularly triangular, pointed inwardly, with clear stigmatal spot, with uncolored posterior angles, and with one or two hairs arising from extreme posterior lateral point of colored blotch; eight segment wholly colored; ninth uncolored, rounded, with only very small hairs; central space of abdomen uncolored; a rectangular genital blotch with backward projecting posterior angles showing through on sixth and seventh segments.

Docophorus fuliginosus n. sp. (Plate iii, fig. 2.)

A few specimens from a Black-bellied Plover, *Charadrius squatarola* (Lawrence, Kansas), and a single male from a specimen of the same bird-species shot near Palo Alto, California. The new species belongs to the group *rotundati* (with convex or truncate clypeus) of Piaget's super-group *latitemporales*, which includes the *Docophori* of the shore birds. This group closely resembles the group *pustulosi* of the Terns, and this species from *Chara-*

drius very closely resembles the common *melanocephalus* of the Terns.

Description of the male. Body, length 1.62 mm., width .65 mm.; head and thorax smoky golden brown, abdomen dark brown with black markings.

Head, length .60 mm., width .53 mm.; front convex with a narrow uncolored border, and a short hair in each anterior angle; one short, marginal hair in front of the distinct suture, and two behind it; trabeculæ medium; eye inconspicuous, with a short hair; temporal margins with two hairs; occipital margin straight, bare; signature shield-shaped, pale, with acuminate posterior point darker colored; quadrangular space in anterior part of signature slightly darker colored than rest of signature; angulated antennal bands, their continuations in front of the suture as narrow marginal borders, the diverging occipital bands and the marginal temporal borders dark brown; also a narrow occipital border not extending to the sides of the head and interrupted medially.

Prothorax, short, with slightly diverging sides and flatly convex posterior margin; posterior angles with a single hair; color smoky golden brown, with a dark brown lateral border, extending around the posterior angles, and a little way along the posterior margin. Metathorax short, broad, with widely diverging short sides, and broadly parabolic posterior margin thickly set with a series of pustulated hairs. Sternal markings consisting of dark brown intercoxal lines, a pale median prothoracic blotch, and a small, pale, triangular metathoracic blotch. Legs, fuliginous with narrow dark brown to black markings.

Abdomen, broadly ovate, turbinated; segment 2 with specially prominent, acute, projecting, posterior angles; segments 4–8 with one to two hairs in posterior angles;

whole abdomen, except segment 9, strongly colored; segments 2–7 with broad black lateral bands; segments with long, transverse, dark brown blotches barely separated medially by an uncolored line, widest on second segment and narrowing on each successive segment; transverse blotches confluent medially on segment 1, with a small, medial, angulated, uncolored emargination on anterior margin; segments 2–5 with a series of pustulations along posterior margin of each transverse blotch, and behind each series a narrow dark brown transversal line; segment 1 with but two demi-pustulations near mesal end of each transverse blotch; segment 9 with uncolored anterior angles, and a lateral smoky brown blotch with four or five short pustulated hairs; posterior margin truncate with a few rather short hairs; genitalia extending through segments 3–9.

Female, length 2. mm., width .9 mm.; head, length .65 mm., width .65 mm.; transverse blotches of abdomen, except of segment 1, not closely approached mesally; segments 1–6 with series of pustulated hairs along posterior margin of transverse blotch, four hairs in segment 1, six hairs in segments 2–6; blotches on segments 2–5 acute mesally, blotches of segment 6 diagonally truncate, and of segment 7 flatly rounded; a narrow transversal line between succeeding blotches of each side of abdomen; segment 8 wholly colored, with a narrow transverse line running across segment close to and parallel with anterior margin of blotch; posterior margin convex with four hairs.

Docophorus graviceps n. sp. (Plate iii, fig. 3.)

A single male specimen, taken from an American Coot, *Fulica americana* (Bay of Monterey, California); and two females from a Pacific Loon, *Urinator pacificus* (Bay of Monterey, California).

Description of male. Body, length 2. mm., width .72 mm.; pale golden brown, with characteristic angulated, black, lateral abdominal markings; abdomen Nirmoid, head large and just as broad as long.

Head, length .62 mm., width .61 mm.; broadly conical; clypeus with uncolored, truncated, frontal margin, and rounded angles; a very fine short pair at middle of each rounded anterior angle, and one at the suture; temporal margins with one short prickle and three long hairs; eye with a short hair; trabeculæ broad, acute-angled; antennæ short, thick; signature pale smoky brown, broadly hexagonal; posterior margin slightly rounding; on each side of the signature a similarly colored elongated triangular blotch apex anteriorly; ground color of head pale golden brown with darker mandibles, broad curving antennal bands, narrow temporal margin, and occipital bands convex outwardly; occipital margin straight.

Prothorax, short, broad, a single short hair in posterior angle, and anterior margin deeply emarginated and projecting under the head; broad lateral margins and forward projecting anterior processes dark brown. Metathorax, short, broad, with rounding lateral margins; with a short prickle at rounding anterior angle, a short prickle and long hair in middle of side, and one long and two short hairs at rounding posterior angle; posterior margin slightly convex on abdomen.

Abdomen, long, ovate, with obtuse posterior angles of segments projecting along lateral margin, the angles of segments 1–6 bearing a single hair, 7–8 with two hairs; first segment with brown triangular blotch in anterior angles, segments 2–7 with brown transverse blotches covering almost entire segment; along lateral margins on each segment a sharp blackish angulated line extending forward into preceding segment; inside of this broken marginal line the stigmatal series, and still inside a faint continuous uncolored line; transverse blotch on segment 8 curving, and the lateral line narrow and sinuous; segment 9 but weakly colored; the genitalia extending forward into the eighth segment, and with distinct small claws at posterior end.

The female specimens were so distorted in preparation as to preclude any careful description. The ninth segment is small but distinct, feebly and broadly emarginated, and has two lateral triangular pale brown blotches. The general abdominal markings similar to male, the characteristic angulated black lateral lines being present.

Docophorus acutipectus n. sp. (Plate iii, fig. 4.)

A single female taken on the Rhinoceros Auklet, *Ceratorhina monocerata* (Bay of Monterey, Cal.) This species resembles *D. celedoxus* Nitzsch, taken on *Alca torda*, *Uria troile* and *Fratercula arctica*, but differs in the absence of sternal markings, the almost failing emargination of the clypeus, the character of the genital blotch of the female, and in the larger size.

Description of female. Body, length 1.94 mm., width .7 mm.; golden brown with darker markings, middle space in abdomen whitish.

Head length .56 mm., width .56 mm.; general markings and shape of *celedoxus;* front of clypeus with very faint emargination, one short marginal hair and another just in front of suture; trabeculæ large, obtuse, reaching to middle of second segment of antenna; antennæ with short thick first segment, second segment longest, bearing a short dorsal hair, third and fourth short, equal, fifth longer; temporal margin with two hairs, eye with a short hair, occipital border straight; signature pale smoky brown, long, with posterior acuminate point, darker colored; suture distinct; dark brown antennal bands, continuing in front of suture, behind it angularly curving; occipital bands diverging, and separated from antennal bands by an uncolored line.

Prothorax short with lateral margins obtusely angulated and bearing one hair in angle; broad lateral colored border, anterior border colored, median uncolored space. Metathorax obtusely angled laterally, long and acutely angled on abdomen, three hairs in margin behind lateral angle, broad lateral borders colored. No sternal markings. Legs concolorous with body.

Abdomen elongate ovate; first segment wholly colored except for distinct narrow median uncolored line not reaching quite to posterior border of segment; segments 2–7 with lateral blotches, on segments 2–5 pointed within, on segments 6–7 blunt within; each blotch with stigmatal spot and several wholly or partly enclosed small circular clear spots along posterior margin; segment 8 longer and wholly colored, segment 9 short with two lateral flecks; genital blotch of under side with frontal transverse bar, and extending backward two pointed elongate triangular spaces, lateral ends of the transverse bar diagonally truncate.

Docophorus quadraticeps n. sp. (Plate iii, fig. 5.)

A male and a female taken from an American Coot, *Fulica americana* (Monterey, California). This species closely resembles *kansensis*, taken from an American Eared Grebe, *Colymbus nigricollis californicus* (Lawrence, Kansas). It differs from it by its larger size, the more rotund abdomen, in the distinctly long acuminate signature, and less markedly in the genital blotch.

Description of female. Body, length 1.87 mm., width .87 mm.; short golden brown with narrow dark margins of thorax and anterior half of abdomen, and short triangular abdominal blotches with few large pustulations.

Head, length .6 mm., width .6 mm.; broadly conical, forehead especially broad; front truncate with a hair on dorsal surface in rounded anterior angle, projecting forward behind the hair two very short ones (not marginal, and showing through from underside), and behind them a very long hair; at suture a short marginal hair, and behind the suture two curving hairs on dorsal surface near the margin and projecting beyond the margin; trabeculæ large, broad and colored at base with rapidly tapering uncolored tip; antennæ, weakly colored, first segment thick, second segment slender as long as first segment, third, fourth and fifth short and about equal; temporal angles with three long pustulated hairs, also a marginal hair just behind the eye and a long one in the eye; occipital margin slightly convex in the middle and slightly concave each side of the middle; signature pale, broad, truncate anteriorly and with long, acuminate, darker colored tip projecting beyond the mandibles; antennal bands pale, interrupted by the distinct clypeal sutures, and coalescing with the much darker, conspicuous, widely diverging occipital bands; temporal margins narrowly edged with black.

Prothorax short with rounding angles, posterior margin flatly convex and a single long pustulated hair behind the posterior angles; lateral margins with even black borders bending inwards, narrowing and paling on posterior margin. Metathorax broadly pentagonal, posterior margins thickly set with a line of long pustulated hairs; lateral margins unevenly bordered with dark brown and black, broadest in lateral angles. Legs smoky with darker markings, and uncolored extremities of tibiæ, tarsi and claws.

Abdomen ovate, with several long marginal hairs in posterior angles of segments; segments 1–7 each with a lateral, brown, triangular blotch, with an outer, marginal, narrow, blackish line contiguous to the anterior margin of the segments, but leaving an uncolored space about one-third the length of the segment between the hind margin of blotch and posterior margin of segment; each segment with a single transverse series of long hairs pustulated along the posterior margin of the triangular markings, but not pustulated in the median, uncolored portion of the segment; a conspicuous, clear, stigmatal spot in each blotch; triangle of first segment extending furthest inwards (nearly to median line), and shorter on each succeeding segment; eighth segment wholly colored; ninth segment uncolored, short and emarginated; a large, broadly crescentic, genital blotch with a median, angulated projection in posterior concave border on ventral face of segments 6–7.

Male, length 1.5 mm., width .4 mm.; head, length .53 mm., width .5 mm.; abdomen short, broadly ovate, with triangular blotches prolonged inwardly; ninth segment flatly rounded behind with a few rather long hairs.

Docophorus montereyi n. sp. (Plate iii, fig. 6.)

Abundant on the Ancient, Marbled and Aleutian Murrelets, *Synthliborhampus antiquus*, *Brachyrhampus marmoratus* and *Ptychorhampus aleuticus* (Bay of Monterey, California). Specimens were taken from forty-six individuals out of fifty-five birds of these species shot.

Description of male. Body, length 1.56 mm., width .53 mm.; head large, pale golden brown, abdomen dark, thorax and abdomen with black lateral border.

Head, length .47 mm., width .43 mm.; uncolored front of clypeus very slightly expanded, rounded with a single marginal hair on the side in front of the suture; trabeculæ large reaching almost to the middle of the second antennal segment; antennæ with first segment thick and about as long as second, third and fourth very short, equal, fifth longer than third or fourth; eye with short curving hair; temporal margins with two hairs; occipital margin straight, even slightly convex noticeable at least medially; color pale smoky brown; signature shield shaped with produced acuminate posterior angle not reaching the mandibles, darker colored; antennal bands dark brown, distinct, posterior ends turning diagonally inwards, anterior ends where interrupted by the suture turning in toward the base of the point of the signature, and tapering to an acuminate point; occipital bands dark brown, narrow, uniform, widely diverging, and separated from the antennal bands by a pale diagonal space; region immediately contiguous to the eye dark brown.

Prothorax short, broad, sides diverging, a single long hair in posterior angles; hexagonal, the middle third of the posterior margin making a very obtuse but distinct angle with the lateral thirds; a broad, uniform, dark brown to black border on the lateral margins and lateral thirds of the anterior and posterior margins. Metathorax with sides rapidly diverging; posterior margin with rounding angle on the abdomen, and a series of about fourteen pustulated hairs ranged along its entire length from lateral angle of one side to lateral angle of the other side; lateral margins bordered with dark brown to black; an anterior medial region almost uncolored; rest of segment fuscous. Legs concolorous with head and prothorax, with darker markings.

Abdomen short, suborbicular, turbinated, hinder segments with one to three longish hairs in posterior angles; segment I wholly colored, fuscous, with the blotch angulated medially on posterior margin and emarginated narrowly on anterior margin; remaining segments except the last with a long, lateral, transverse, fuscous blotch preceded by an equally long, transverse, fuscous line, these blotches and lines black along lateral margin of body forming broad, black, lateral, abdominal bands; the blotches and lines separated medially by a pale, almost uncolored space on segments 2–5; on segments 6–7 and on posterior half of segment 5 the blotches and lines coalesce on the median line; several pustulated hairs ranged along posterior margins of blotches on segments 2–6; last segment flatly rounded posteriorly with several longish hairs, a curving, transverse, medial blotch, and regions of the anterior angles uncolored.

Female, with transverse blotches of segments 2–7 of abdomen very short, beginning with anterior segments successively acute, diagonally truncate, and truncate on inner ends, the usually three pustulated hairs conspicuous; large medial space of abdomen whitish; last segment fuscous, with five longish hairs in two groups, one of two and one of three, on each side; measurements, length 1.75 mm., width .7 mm.; head, length .53 mm., width .51 mm.

Docophorus occidentalis n. sp. (Plate iii, fig. 7.)

An abundant species on the Pacific Coast varieties of the Fulmar, *Fulmarus glacialis pacificus* and *F. g. rodgersii;* found on twenty-nine of thirty of these Fulmars shot on the Bay of Monterey, California. Two specimens, probably stragglers, taken on two Surf Scoters, *Oidemia perspicillata* (Bay of Monterey).

Description of the male. Body, length 1.56 mm., width .7 mm.; short, broad, strongly-colored, with black abdominal bands and triangular, lateral, abdominal blotches.

Head, length .53 mm., width .53 mm.; conical, with truncate or weakly convex front; three very small marginal hairs, one of which is slightly in front of suture; trabeculæ reaching slightly beyond base of the second antennal segment; antennæ colored except at sutures, second segment longest, third, fourth and fifth segments about equal; temporal angles with two hairs; eyes with a short spine; occipital margin straight or slightly convex; signature broadly shield-shaped, constricted near the front, anterior margin truncate or slightly emarginated, posterior margin with a darker colored obtuse angle; angulated antennal bands dark colored and specially distinct; occipital bands distinct, widely diverging, and interrupted by a diagonally transverse uncolored line; temples dark brown, narrowly margined with black; occipital margin between bases of occipital bands with border of same width and color as occipital bands, paler in the middle.

Prothorax short, broad with slightly diverging sides and rounded posterior angles, with one hair; with marginal lateral bands bending inwards along posterior margin. Metathorax pentagonal, angled on abdomen, with a series of seven pustulated hairs ranged along latero-posterior margins beginning at lateral angles; last hair of each series removed from others and near the posterior angle; segment mostly brown, with a dark lateral blotch in each lateral angle extending indistinctly along latero-anterior sides. Legs light brown, with dark brown markings. Sternal markings consisting of a short, broad, transverse line in front of the mesocoxæ, terminating inwardly in an expanded circular spot; a distinct, narrow, transverse, intercoxal line between meso- and metacoxæ, bending backward and margining narrowly the coxal cavity, and four small median spots, the hindmost of which is the largest.

Abdomen short, broadly ovate, segments 1–7 with elongate, narrow, brown triangles, with acute apex inwardly; each one of segments 2–6 with three pustulated hairs, one near the lateral margin of the triangle and two near the apex, all along the posterior margin of the triangle; segment 1 with one pustulated hair near the middle, and segment 7 without hairs; segment 8 with narrow curving, transversal, nearly continuous brown band, and segment 9 wholly colored but paler; outer margin of each triangle broadly black, producing black lateral abdominal bands; posterior margin of segment 9 flatly rounded, with about ten longish hairs; segments 3–7 with one to three longish hairs in posterior angles; genitalia extending forward to third segment, and posterior pincer-like portion very strong.

Female. Body, length 1.8 mm., width .78 mm.; head, length .53 mm., width .53 mm.; pustulated hairs of metathorax at subequal distances apart; triangular blotches of abdomen not projecting so far inwardly, and with but two pustulated hairs; segment 8 wholly colored; segment 9 very small, uncolored, with two small lateral blotches, posterior end truncate, and with one short spine at each posterior angle; genital blotch on ventral face of segments 6–7, transverse anteriorly, with two posteriorly projecting pointed processes.

Docophorus kansensis n. sp. (Plate iii, fig. 8.)

A single female specimen taken from an American Eared Grebe, *Colymbus nigricollis californicus* (Lawrence, Kansas). The new form somewhat resembles *colymbinus* (Piaget, Les Pediculines, 1880, p. 117, pl. x, fig. 5, from *Colymbus septentrionalis*), especially in the shape and markings of the head; but the well-defined and characteristic abdominal markings are very different from the abdominal markings of *colymbinus*.

Description of female. Body, length 1.6 mm., width .64 mm.; pale golden brown, with darker, narrow, thoracic borders and short, lateral, triangular, abdominal blotches bearing a few, long, pustulated hairs.

Head, length .47 mm., width .44 mm.; broadly conical, front broad, slightly convex with a shallow median emargination; a hair arising from the dorsal surface near the obtuse anterior angle projects forward beyond the margin; behind this two short hairs (not marginal and showing through as in n. sp. a) and behind these a rather long hair; two short marginal hairs; trabeculæ long and rather slender, acutely-tipped; antennæ long; temporal angles with three hairs, also one hair just behind the eye, and one in anterior angle of eye; occipital border slightly convex; forehead much paler colored than hind head; signature short with slightly concave anterior margin and obtusely angled hinder margin; antennal and internal bands pale, temples and widely separated occipital bands darker.

Prothorax subquadrangular; rounded posterior angles with one hair; posterior border straight; distinct, regular, colored lateral borders. Metathorax pentagonal; with two non-pustulated hairs in lateral angle and five pustulated hairs ranged along each latero-posterior margin; uniform lateral colored border. Legs pale colored except tarsi and claws.

Abdomen, elongate ovate, without angulated lateral projections, with a few pustulated hairs on surface, and one or two rather longish hairs in posterior angles; segments 1–7 with lateral trangular blotch bearing three or four pustulated longish hairs ranged along posterior border of blotch; an uncolored stigmatal spot in each blotch; the lateral margins of segments 1 and 2 (less distinctly in 2) bordered with dark brown like the thoracic segments; segment 8 with transverse blotch extending entirely across the segment; and segment 9 uncolored or faintly colored, with slight emargination and only a few very short hairs.

Docophorus atricolor n. sp. (Plate iii, fig. 9.)

Not uncommon on the Ancient and Marbled Murrelets, *Synthliborhampus antiquus and Brachyrhampus marmoratus* (Bay of Monterey, California). This species is closely related to *colymbinus.*

Description of male. Body, length 1.75 mm., width .71 mm.; rather elongate, Nirmoid in shape, darkly colored all over with wide, black, lateral, abdominal bands.

Head, length .53 mm., width .6 mm.; slightly broader than long, front broad, with shallow rounding emargination, uncolored portion of clypeus slightly expanded, anterior angles rounding; one very short fine marginal hair at indistinct suture; trabeculæ small; antennæ short and slender; temporal margins with two long hairs; eyes flat with a spine; occipital margin concave; clypeal signature broad anteriorly, with truncate front margin, tapering slowly posteriorly to truncate, posterior margin reaching the mandibles; antennal bands darkly brown, right-angled, with posterior ends extending transversely inwards to mandibles; occipital bands distinct, slightly diverging and separated from forehead by a transverse, weakly colored, linear space behind antennal bands; temporal regions brown with margins darker.

Prothorax, small with anterior margin emarginated and projecting under the head; lateral and anterior margins distinctly and evenly bordered with dark brown to black, rest of segment brown; a short spine on lateral margin, and at rounded posterior angle a single hair. Metathorax short, broad, posterior margin flatly convex, angles rounded; a long hair and short spine in an uncolored space in front of middle of lateral margin, and three long hairs in posterior angle; segment wholly colored with darker, small, lateral, marginal blotch, in which is located the clear space containing hair and spine. Legs brown with darker markings.

Abdomen elongate, elliptical, segments short of about equal length; each segment with two weak median hairs on dorsal surface; whole colored dark smoky brown except tip of ninth segment; broad black lateral bands, connected on each segment by a narrow transverse black bar across middle of segment; on first segment this bar broader, covering nearly whole surface of segment, and with a narrow uncolored median line; ninth segment truncate behind with flatly rounded posterior angles; a series of short pustulated hairs along posterior margin; genitalia in segments 8 and 9, side pieces with a distinct toothed posterior claw.

Female, same size; not so dark; ninth segment emarginated for one-half its length, the points being obtusely angled, and with one very short hair each.

Docophorus insolitus n. sp. (Plate iv, fig. 5.)

A few specimens, male and female, taken from an Aleutian Murrelet, *Ptychorhampus aleuticus* (Bay of Monterey, California). This species was not found on other of the numerous individuals of the same bird species taken at Monterey.

Description of female. Body, length 1.65 mm., width .50 mm.; elongate, narrow, Nirmoid in general appearance, with long trabeculæ and distinct clypeal suture; color of head and thorax yellowish brown, abdomen whitish, with strongly marked dark brown bands of the head, borders of thorax, and blackish abdominal lateral bands, and brown transverse blotches.

Head, length .5 mm., width .4 mm.; large in comparison with total size of body, the head being nearly one-third of the total body length, elongate conical; that part of the head in front of the mandibles specially long; front broad, convex, with the margin finely crenulate; three small lateral marginal hairs on forehead; trabeculæ large, blunt; eye with a short hair; temporal angles rounded, with two rather short curving hairs; occipital margin straight; bands of the head, viz., broad antennal, diverging occipital, distinct ocular reaching the tips of the occipital, and narrowly marginal, dark brown and well marked; pale brown signature large, with dark brown posterior angle not reaching mandibles and rather blunt.

Prothorax short, broad, with rounded angles and convex posterior margin; one hair in posterior angles; distinct dark brown lateral and anterior borders, also extending inwards from the posterior angles along the posterior margin, but not meeting; median space almost uncolored. Metathorax pentagonal, with rounding lateral angles and six hairs on each latero-posterior margin; broad lateral dark brown border, broadest in lateral angles. Legs concolorous, with pale brown tinge of body, tarsal claws darker.

Abdomen elongate, narrow, posterior angles of segment 2 produced, acuminate; lateral margins with two longish hairs, a few longish hairs on dorsal aspect; lateral bands semitranslucent smoky brown, composed of a series of slightly diagonal, narrow, marginal blotches, one on each segment, each blotch widest anteriorly, tapering posteriorly and not quite reaching the posterior angle of the segment; segments 1–7 with lateral transverse blotches, those on segment 1 meeting on the median line; large median region of abdomen whitish; segment 8 wholly colored; segment 9 small, uncolored, with very slight angular emargination; genital blotch a narrow, curving, transverse band across segment 6.

Male. Smaller, length 1.34 mm., width .38 mm.; head, length .47 mm., width .37 mm.; metathorax almost wholly fuscous; the lateral transverse blotches of abdomen longer, those on segments 6–7 almost, if not quite, meeting on median line; last segment broadly rounded with several hairs; genitalia pincer-like.

Docophorus icterodes Nitzsch. (Plate iv, fig. 1.)
Germar's Mag. Entomol., 1818, vol. iii, p. 290.

Pediculus dentatus Scopoli, Entomol. Carniol., 1763, p. 383.

Docophorus icterodes Nitzsch, Burmeister, Handbuch d. Entomologie, 1832, vol. ii, p. 424; Gurlt. Mag. f. ges. Thierheilk., 1842, vol. viii, p. 415; Denny, Monograph. Anoplur. Brit., 1842, p. 101; pl. v, fig. 11; Grube, v. Middendorff's sibir. Reise., 1851, vol. ii, part 1, p. 468; Giebel, Insecta Epizoa, 1874, p. 115, pl. x, fig. 8; Piaget, Les Pediculines, 1880, p. 114, pl. x, fig. 1.

Specimens of this common parasite of ducks taken on the Surf Scoter, *Oidemia perspicillata*, the Ruddy Duck, *Erismatura rubida*, the Red-breasted Merganser, *Merganser serrator* (Bay of Monterey, California); and from the Mallard, *Anas boscas*, the Greenwinged Teal, *Anas carolinensis*, the Redhead, *Aythya americana*, the Lesser Scaup, *Aythya affinis*, and the Pintail, *Dafila acuta* (Lawrence, Kansas). Piaget, Giebel and Denny list fully a dozen species of ducks on which *icterodes* has been found.

Giebel has described (Insecta Epizoa) three other species of *Docophorus* (*adustus*, p. 113, *brevimaculatus*, p. 114, and *brunneiceps*, p. 114) found on ducks, and Rudow one species (*natatorum*, Zeitsch. f. ges. Naturwiss, 1870, vol. xxxv, p. 453), all of which Piaget holds to be synonyms of *icterodes*. Piaget doubts also the validity of two or three other of Giebel's species of duck-infesting *Docophori*. The wide geographical and zoological distribution of the species render variations inevitable, and its abundance on such common birds as ducks renders inevitable the observation of these variations.

The measurements of the male specimen figured are: body, length 1.4 mm., width .52 mm.; head, length .44 mm., width .4 mm. The species is easily recognizable by its conspicuous rounding, uncolored clypeus with colored signature, and on each side of it the triangularly-headed anterior projection of the antennal band.

Docophorus pertusus Nitzsch. (Plate iv, figs. 2 and 3.)

Germar's Mag. Entomol., 1818, vol. iii, p. 290.

Docophorus pertusus Nitzsch, Burmeister, Handbuch d. Entomologie, 1832, vol. ii, p. 426; Giebel, Insecta Epizoa, 1874, p. 108, pl. xi, figs. 3, 12; Piaget, Les Pediculines, 1880, p. 89.

Males, females, and young from eight out of eleven specimens of American Coot, *Fulica americana* (Monterey, California), and from one out of three specimens of same bird species taken at Lawrence, Kansas. A single specimen was taken from a Ruddy Duck, *Erismatura rubida* (Monterey, California). The Ruddy Ducks and Coots are such constant associates that it is not surprising to find this Coot parasite occasionally on this species of duck. Also a single male was taken from an American Eared Grebe, *Colymbus nigricollis californicus* (Bay of Monterey, California). The characteristic forcipated appearance of the clypeus easily distinguishes the species; in some specimens the "pincers" will be found closed, so that the deep frontal emargination is quite enclosed, while in others the "pincers" will be open. My specimens do not agree with Giebel's figures and Piaget's description as to length of signature; in my specimens the acuminate posterior point extends quite to the mandibles. I figure a female, and an immature specimen. The young stage is interesting, as it shows no evidence of the pincer-like condition of the clypeus, and the clypeal signature is arrested far in front of the mandibles. The measurements of the specimens figured are: Female, body, length 2. mm., width .92 mm.; head, length .6 mm., width .6 mm. Immature, body, length 1.7 mm., width .84 mm.; head, length .52 mm., width .5 mm. Nitzsch's specimens were found on *Fulica atra*.

Docophorus lari Denny. (Plate iv, fig. 4.)

Monograph Anoplurorum Britanniæ, 1842, p. 89, pl. v, fig. 9.

Pediculus lari Fabricius, Fauna Groenlandiça, 1780, p. 218.

Philopterus lari Fabr., Walckenær, Hist. Nat. Ins. Apt., 1844, vol. iii, p. 337.

Docophorus gonothorax Giebel, Zeitschr. f. ges. Naturwiss., 1871, vol. xxxvii, p. 450; Giebel, Insecta Epizoa, 1874, p. 111.

Docophorus congener Giebel, Insecta Epizoa, 1874, p. 111.

Docophorus lari Denny, Piaget, Les Pediculines, 1880, p. 111, pl. ix, fig. 7.

Many specimens of this common parasite of the gulls on *Larus argentatus smithsonianus*, *canus*, *occidentalis*, *brachyrhynchus*, *glaucescens*, *heermanni*, *vegæ*, *delewarensis*, *glaucus* and *Rissa tridactyla pollicaris* (Bay of Monterey, Cal.), and from *Larus delewarensis* (Lawrence, Kansas). In all, I have examined eighty-seven specimens of gulls of the various species mentioned, and have collected this parasite on seventy-eight of them. Piaget and others have found this parasite on *Larus canus*, *marinus*, *fuscus*, *glaucus*, *argentatus*, *ridibundus*, *atricilla*, *islandicus*, *leucophæus*, *cyanorhynchus*, *Pagophila eburnea*, *Rissa tridactyla*, *Sulla bassana*, and *Lestris parasiticus*. I have found males, females and young of this parasite on *Colymbus nigricollis californicus* and *Urinator lumme;* these can hardly be stragglers.

Piaget has named and briefly described three varieties of this species, there being apparent a considerable variation in size, in shape of the clypeus and character of the male genitalia. The careful examination of a large number of specimens from different species of gulls is necessary for an understanding of the condition of the species. I hope to have opportunity to make such a study soon.

The species is easily recognized by the strong markings, broad truncate clypeus and large acuminate signature. The female specimen figured measured as follows: body, length 2. mm., width .93 mm.; head, length .62 mm., width .63 mm.

Despite the smaller size I do not understand, from the description, how Picaglia's *D. larinus* (Atti d. Soc. Ital. d. Sci. Nat., 1885, vol. xxviii) differs specifically from *lari.*

Docophorus melanocephalus Burmeister. (Plate iv, fig. 6.)

Burmeister, Handbook d. Entomologie, 1832, vol. ii, p. 426.

Docophorus laricola Nitzsch. (*in pars*) Zeitschr. f. ges. Naturwiss. (ed. Giebel) 1866, vol. xxviii, p. 363.

Docophorus caspicus Nitzsch. Zeitschr. f. ges. Naturwiss. (ed. Giebel) 1866, vol. xxviii, p. 361, fig. 87.

Docophorus melanocephalus Burm. Giebel, Insecta Epizoa, 1874, p. 110, Pl. xi, fig. 8; Piaget, Les Pediculines, p. 109, pl. ix, fig. 5.

Many specimens taken from the Royal Tern, *Sterna maxima.*

This is the most abundant parasite of this Tern (Bay of Monterey, California). I found it on every one of fourteen specimens shot. The European authors record its occurrence on *Sterna caspia*, *cantiaca*, and on *Larus ridibunda* and *cirrocephalus* (localities?). Giebel describes also as a distinct species *lobaticeps* (Insecta Epizoa, p. 109), a closely related, if not identical, form taken on *Sterna hirundo* and *Sterna fissipes.* Piaget believes *lobaticeps* to be identical with *melanocephalus.*

The distinguishing characters of *melanocephalus* are its general dark color, its especially dark colored head, prominent signature with long acuminate point reaching the mandibles, slightly convex clypeal front, and the presence of a small spine and a short hair in the eye. The measurements of the female specimen figured are: Length 2.1 mm., width .9 mm.; head, length .65 mm., width .65 mm.

Nirmus præstans n. sp. (Plate v, figs. 1 and 2.)

Taken on the Royal Tern, *Sterna maxima* (Bay of Monterey, California). But two specimens, both males, of this new *Nirmus* were taken, one from each of two birds. The new form belongs to the group *nigropicti*.

Body, length 3.25 mm., width .5; with marginal markings of black, and abdominal blotches of chestnut brown.

Head, length .56 mm., width .5 mm.; broadly conical, widest at posterior angles, with temporal margins and margins of forehead in nearly straight diagonal lines; clypeus truncate in front (even slightly concave), with three lateral short hairs; signature with broad anterior margin colored (brown); a rather broad lateral black line interrupted posteriorly by the suture, but reappearing behind the suture as a black blotch; antennal bands black, outer ends curving forward; trabeculæ distinct, as long as first antennal segment; antennæ with second segment longest, fifth longer than third or fourth which are equal, uncolored, except the fifth segment, which is light brown with distinct short hairs on tip; eyes with a bristle; temporal margins narrowly bordered with black and with one long hair; occipital angles rounded, posterior border doubly emarginated; occipital signature black and labium brown, visible on under side; mandibular rami strongly colored.

Prothorax quadrangular, much narrower than head; angles obtuse to rounding; lateral margins strongly and broadly colored, the colored band running inward along the posterior margin for about one-third the length of the margin and slightly expanded at inner end. Metathorax, transverse, five sided, lateral margins with a feeble concavity, posterior angles rounding with five separated, strong, pustulated hairs arranged, irregularly spaced, the three outermost close together, in a row extending inwards along the posterior margin; posterior margin obtusely angled on the abdomen; lateral margins with a strong, dark brown, linear blotch expanding at the ends; sternal markings consisting of broad intercoxal lines, and a triangular median blotch on metathorax. Legs mostly uncolored, with femur semiannulated with dark brown at basal and distal extremities; tibiæ annulated at distal end; tarsus light brown; claws uncolored.

Abdomen, elongate ovate; posterior angles of segments with few hairs; surface glabrous, first segment without transparent lateral margin, with circular black spot in anterior angle; segments 2–6 with transparent lateral margin, narrower posteriorly; in each anterior angle a black, linear, obliquely directed blotch produced anteriorly across the suture and into the preceding segment; on segment 7 this blotch very faint or obsolete; at the posterior angle a small distinct blotch; on the eighth segment a small marginal blotch, and on the ninth a transversal, curving, brown line; on the dorsal surface a small, short, curving, median, transversal brown line on the second segment, and a similar slightly larger one on the third segment; on segments 3–6 the broad transversal blotches of the ventral surface show through, as also do the chitinized parts of the genitalia; on the ventral surface there are median transversal brown markings as follows: on the first segment a small wide triangle, on the second segment a semiellipse with convex side forward, on segments 3–6 broad transverse blotches largest on segments 4–5; genitalia showing distinctly; one or two hairs at posterior angles of segments 1–7; segment 8 with a strong, long, hair and a shorter one on lateral margin; segment 9 with strong hairs arising from dorsal and ventral surfaces of the rounded posterior margin, in all about ten.

Nirmus hebes n. sp. (Plate v, fig. 3.)

A single poorly-preserved specimen from a Royal Tern, *Sterna maxima* (Bay of Monterey, California).

Description. Body, length 1.72 mm., width .5 mm.; strongly marked, abdomen with large, lateral, transverse blotches and an uncolored longitudinal median line.

Head, length .47 mm., width .35 mm.; elongate conical, front truncate, bare (?); trabeculæ small but distinct; temporal margins subparallel, with one hair near posterior angle; antennal bands distinct, dark brown, bending inwards at the suture, and with posterior extremity expanded; temporal margins narrowly edged with dark brown; occipital bands indistinct, diverging, more strongly colored at base.

Prothorax with rounded angles, bare (?); posterior margin flatly convex, with colored lateral border. Metathorax with rounded anterior angles, diverging sides and obtuse posterior angles; angulated on abdomen; two or more hairs in posterior angles; lateral borders colored. Legs concolorous with body, with darker narrow margins. Sternal markings consisting of two pairs of intercoxal lines.

Abdomen elongate elliptical; posterior angles of posterior segments with short hairs; each of segments 2–7 with a marginal black blotch, widest anteriorly and projecting inward along the anterior margin of segment, but paling to brown; this projection stops at a median, longitudinal, uncolored line, turns posteriorly to the posterior margin of the segment and runs along the segment outwardly for a short distance; that part of the lateral portion of the segment not colored by this black and dark brown curving blotch is golden brown; segment 8 wholly colored with narrow, black, lateral margin; segment 9 uncolored, with two small, brown blotches; posterior margin feebly emarginate.

Nirmus farallonii n. sp. (Plate v, fig. 4.)

A single female specimen taken from a Farallone Cormorant *Phalacrocorax dilophus albociliatus* (Bay of Monterey, Cal.) An immature specimen taken from a Western Grebe, *Colymbus septentrionalis* (Bay of Monterey, Cal.) is also probably of this species. It may be a straggler. In general marking and outline this new species resembles *Nirmus dispar* Piaget, taken by the namer on a *Carbo sulcirostris* from a skin in the Leyden Museum. *Dispar* is a much smaller species, and lacks the characteristic median abdominal blotches of *farallonii*.

Female. Body, length 2.66 mm., width .84; ground color pale clear brown; strongly and extensively marked with dark brown.

Head, length .6 mm., width .53 mm.; conical, narrow in front and rounding; five marginal hairs, a long one on dorsal surface between the front two and two shorter ones on dorsal surface near the fourth marginal; trabeculæ small and nearly obtuse; temporal margins rounding and with one long hair and several short prickles; occipital margin slightly concave; eyes prominent, with a very short prickle; antennæ short, second segment longest, third and fourth about equal, fifth longer, concolorous with pale ground color of head; clypeal signature distinct, short pentagonal, with hinder margins and posterior angle rounded; whole head, except small parts of clypeus, pale brown; antennal bands broad, distinct, bending in at suture; small black ocular flecks, and converging occipital bands.

Prothorax shorter than broad, quadrangular with rounding angles; one long hair and one short thorny hair at posterior angle; color brown, with darker lateral bands which expand into triangular dark brown blotches in posterior angles. Metathorax broader than long, quadrangular with lateral margins diverging slightly, and anterior angles distinctly expanding and tubercular in front of a constriction; posterior margin straight; posterior angles with one long and one short hair in point of angle, and near them five long hairs set in an elliptical clear space; brown, palest in center, lateral bands very dark in posterior two-thirds, and bending in along anterior margin. Legs colored.

Abdomen elongate elliptical, with posterior angles projecting, and two or three rather long hairs in each angle; a few long hairs on dorsal surface; segment 1 all brown, others with strong, quadrangular, lateral, brown blotches, black on outer margin, and with uncolored stigmatal spots and a median quadrangular light brown blotch; posterior angles uncolored; segments 8–9 undivided, but with distinct blotches and no median blotches; segment 9 rounding, hardly if at all emarginated, and with only a few short hairs.

Nirmus orarius n. sp. (Plate v, fig. 5.)

A single specimen from a Golden Plover, *Charadrius dominicus* (Lawrence, Kansas). This form is a member of the group *obscuro-suturati*, and resembles somewhat my species *bœphilus* from a Killdeer Plover, *Ægialitis vociferus;* the body, however, is shorter and not parallel-sided, though the form is still a slender, graceful one.

Female. Body, length 1.84 mm., width .4 mm.; pale with narrow distinct marginal markings.

Head, length .5 mm., width .28 mm.; head elongate conical, with expanded uncolored part of clypeus in front not angulated as in *bœphilus*, but rounding; three clypeal hairs and one on dorsal surface in front of the trabecula projecting over the margin; trabeculæ small, clear, but distinct; temporal margins weakly convex with two long hairs; occipital margin faintly concave; eyes flat with a long hair; antennæ uncolored, short; clypeal signature uncolored; mandibles and labium brown, a narrow lateral brown margin along forehead interrupted in front of antennæ and at suture and along temples.

Prothorax markedly narrower than head; quadrangular, with sides converging slightly toward front; one hair in posterior angle; with brown marginal band distinct along posterior margin. Metathorax but little longer than prothorax, wider, with rapidly diverging lateral margins; posterior margin angulated; four long hairs in posterior angles, grouped in pairs, one pair being a short distance inward on posterior margin; an interrupted, lateral, brown band and a long, triangular, brown blotch projecting inwards from middle of lateral margin. Legs uncolored with weakly colored tarsi.

Abdomen elongate, with convex sides, not parallel; segments of about equal length; segment 9 short and with weak, rounding emargination on posterior margin; a few scattered weak hairs on surface, and segments 5–8 with one or two weak hairs in posterior angles; a narrow, lateral band emphatic in anterior part of each segment and margined outwardly by a narrow clear space; segments 1–6 with large, median, pale brown transverse blotch.

Nirmus giganticola n. sp. (Plate v, fig. 6.)

This well-marked *Nirmus* of the group *nigropicti* was taken from the Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). It was found on both of two birds of this species shot. I have not found it on any other bird-species.

Body, length 3.5 mm., width .87 mm.; white with a few definitely arranged black and brown spots; of about the average size and usual shape of the *Nirmi nigropicti*;

body with a few hairs on margins, general surface glabrous.

Description of male. Head, length .75 mm., width .62 mm.; conical, front produced and narrowly rounded, almost angulated; sides of forehead with five hairs, and one short one between the first two which rises on upper surface of clypeus at some distance from the margin; between second and third marginal hairs a short hair rising from surface of head so far inward that its tip does not project over the margin; temporal margins rounding, with few short hairs; occipital margin slightly and broadly concave; trabeculæ wanting; eyes distinct; antennæ with first and second joints longest, each as long as third and fourth, fifth longer than fourth, uncolored; clypeus uncolored; margins of forehead with a short, interrupted, dark brown line; an irregularly shaped dark brown orbital blotch; a small occipital signature; mandibles chestnut brown.

Prothorax rectangular, angles obtuse, glabrous, uncolored, with broad transparent margin. Metathorax trapezoidal, widest at posterior angles; lateral margins slightly concave, deepest before the middle; posterior margin weakly concave; a slender hair at each posterior angle, and in the angular area four long, strong hairs set closely together in a circular, uncolored spot; by each lateral margin just before the middle a conspicuous black triangle with apex directed inwards, situated in a marginal transparent space; no sternal markings. Legs uncolored except distal extremity of tibia and tarsus, which are dark brown; with a few scattered hairs.

Abdomen, third, fourth and fifth segments broadest and of about equal width, eighth much narrower than seventh, ninth very narrow and small; posterior angle of second segment with two hairs; posterior angles of segments 3–6 with three hairs, of seventh with at least four hairs, eighth segment with two hairs at each anterior and posterior angle; ninth segment feebly angularly emarginated with one short stiff hair on each side of the emargination; lateral margins of abdomen transparent, containing entering whitish appendages of clear chitin, and on segments 2–7 a small distinct black blotch near the anterior angle of each segment; seventh segment also with a slightly curving, elongate, black fleck in the posterior angle; eighth segment marked like the seventh except that the posterior blotch is more narrowly linear; segment 9 with a narrow marginal blotch on each side.

Female generally similar to male; abdomen with one hair on posterior angle of first segment, two hairs on segments 2–4, three hairs on segments 5–7; segment 9 more acute than in male and two-pointed; segment 8 with linear blotch extending along whole length of margin; inside of lower end of this blotch and of marginal blotch of ninth segment a curving, linear, brown blotch; opening of vulva with nine stiff hairs on each margin.

This member of the *Nirmi nigropicti* differs markedly by the produced and narrowly rounded clypeus, the long metathorax with acuminate posterior margin, and the entire absence in both sexes of transverse blotches or lines on the abdomen from such forms as *punctatus*, *selliger*, and *lineolatus*, which in general appearance are somewhat similar to this new form.

Nirmus bœphilus n. sp. (Plate v, fig. 7.)

A single female taken from a Killdeer Plover, *Ægialitis vocifera* (Lawrence, Kansas). Packard's outline figure and incomplete description of *Lipeurus gracilis*, host? (Amer. Nat., 1870, vol. iv, p. 95, pl. i, fig. 6) must refer to a form resembling, in shape and markings, at least, this species. The new species belongs to the group *obscuro-suturati*.

Description of female. Body, length 1.95 mm., width .34 mm.; very elongate and slender, parallel-sided, pale with distinct brown marginal bands on head, thorax and abdomen, and with weakly colored and ill-defined transverse abdominal markings.

Head, length .48 mm., width .23 mm.; elongate, conical, with clypeus expanded, and obtusely angled in front and at sides; the expanded part of the clypeus is uncolored; one lateral hair on expanded clypeal portion, two in front of the suture (one rising from dorsal surface and one from ventral), one at the suture, and two rising from the ventral surface and projecting beyond the lateral margin behind the suture, and one long hair rising from the internal band and projecting beyond the lateral margin of the forehead; trabeculæ small but distinct, acute; temporal margins subparallel, with one long hair and one shorter hair; occipital margin concave; eyes inconspicuous; antennæ with second segment longest, fifth next, third next, fourth next, segment 1 short and thick, uncolored, except a faint brownish tinge on segment 5; clypeal signature triangular with apex toward the mandibles; entire lateral margin of head narrowly dark brown, interrupted at clypeal suture and emphasized at beginning of antennal band; uncolored occipital bands converging toward the mandibles, and uncolored internal bands bending outward at suture to meet antennal bands and in front of mandibles to enclose oral fossa.

Prothorax truncated, conical, sides converging in front, with well defined brown marginal bands around the entire segments, and a single hair at posterior angle. Metathorax but little longer than prothorax, wider, also truncated conical with lateral brown bands interrupted at middle, and three long hairs in posterier angle, and one pustulated hair on each latero-posterior margin; a median, long, spear-head shaped sternal blotch of pale brown showing through. Legs with colored tarsi and strong claws.

Abdomen very long, slender, parallel sided, with few scattered long hairs on surface and in posterior angles of segments; segments 8–9 tapering posteriorly; segment 9 slightly but angularly emarginated, without terminal hairs on points; all segments with distinct narrow lateral brown bands, slightly expanding at front of each segment and projecting across the sutures; segment 1 with truncated, conical, paler, median blotch; other segments with indistinct, large, quadrangular, median blotches.

Nirmus punctatus Nitzsch. (Plate vi, figs 1 and 2.)

Germar's Mag. Entomol., 1818, vol. iii, p. 291.

Philopterus grammicus Gervais, Hist. Nat. Apteres, 1847, vol. iii, p. 350.

Nirmus punctatus Nitzsch. Nitzsch. (ed. Giebel) Zeitschr. f. ges Naturwiss., 1866, vol. xxviii, p. 377; Giebel, Insecta Epizoa, 1874, p. 176, pl. iv, figs. 1, 2; Piaget, Les Pediculines, 1880, p. 200, pl. xvi, fig. 4.

A female and two immature specimens taken from a Western Herring Gull, *Larus occidentalis* (Bay of Monterey, California). This species was found by Nitzsch on *Larus ridibundus*, and by Piaget on a *Larus dominicanus* from Chili, a *Larus crassirostris* from China, and a *Larus ichthyaëtus* from the Volgas; a well distributed form, surely. Piaget's figure omits the short hairs at the anterior angles of the clypeus present apparently in all *nigropicti*, and his description consistently with the drawing refers to but three hairs on each side of the clypeus, where there are really four. The specimen is much larger (length 2.4 mm.) than Piaget's seem to have been, the average length of his female specimens being 1.9 mm.

Description of young. Length, 1.5 mm., differing from adult specially in incompleteness of markings and relative shortness of body. Head, length 5 mm., width .41 mm.; more rounding than truncate in front and without colored markings, except dark brown labium and pale brown mandibles; ratio of breadth to length greater than in adult. Thorax with a lateral small black blotch near anterior angle of metathorax. Abdomen, length .81 mm., width .41 mm.; without median markings, a small black blotch at anterior angle of segments 1–7, blotches growing smaller in each succeeding segment.

Nirmus felix Giebel. (Plate vi, figs. 3 and 4.)
Insecta Epizoa, 1874, p. 175.

Two specimens, both males, taken from two specimens of Heerman's Gull, *Larus heermani* (Bay of Monterey, California), may be attributed to this species of Giebel established on a single female taken from the same species of gull. Piaget (Les Pediculines, p. 201) assumes to believe Giebel's specimen a variety of *punctatus*. "Cette spèce ne me paraît non plus qu'une variété du *punctatus* où l'occiput n'est pas bordé de noir et les taches de l'abdomen sont plus allongées transversalement." But the differences between the males taken by me and the male *punctatus* are much more considerable than this. The black bordering of the head and the strong tripartite blotches of the abdomen remove it distinctly from any immediate similarity with *punctatus*; in fact, the species more nearly resembles *lineolatus* than *punctatus* (compare figures 1, 3, 4, 7 and 8, plate vi). Its most striking resemblance, however, is to *præstans*, the transparent clypeus, different abdominal markings and markedly different male genitalia distinguishing it from *præstans*.

Description of male. Body, length 3.66 mm., width .62 mm.; white, with dark brown or black marginal markings, and chestnut brown, median abdominal markings.

Head, length .53 mm., width .50 mm.; conical; clypeus truncate, even slightly concave in front, a short hair at each anterior angle and five other short hairs in the lateral margin between it and the small but distinct trabecula; temporal margin slightly rounding, with two longish hairs, and behind the hinder one two very short, stiff, prickle-like hairs; posterior margin straight; antennæ uncolored, second segment longest, third, fourth and fifth segments about equal; anterior part of clypeus transparent, and a transparent space on each side just inside of trabeculæ; margin of forehead with a twice-interrupted, uneven, black line, the middle third of it not contiguous to the margin and thickly crescentic; a black border along the temporal margins, bending inwards at anterior end; labium black; mandibles chestnut brown.

Prothorax quadrangular, bordered laterally with black, which runs inward along the posterior margin one-third the length of the margin; a single hair at posterior angles. Metathorax pentagonal, bordered on the anterior lateral margins with dark brown, inside of which the short, curving, black, intercoxal lines of the sternum show through; posterior lateral angles with five strong pustulated hairs almost exactly as in *præstens;* posterior margin angulated on abdomen; sternal markings consist of an obtusely-pointed, nipple-like fleck, projecting inwards from lateral margin of metathorax. Legs, femur with brown fleck at basal end and tibia with brown blotch at distal end, tarsus brown, otherwise white; tibia with three short, stiff hairs on inner side and one on outer side; femur with two or three short hairs arising in basal blotch.

Abdomen with segment 4 widest; nearly parallel-sided for most of its length; segment 1 with small black blotch at anterior angles, segments 2–7 with triangular (segments 2–3), or curving, angulated (segments 4–7) blotches in anterior angles, with transparent spots at posterior angles and margins narrowly transparent; segment 8 with irregular black marginal blotch; segment 9 with two short chestnut lines parallel with posterior rounding margin; on dorsal surface of segments 2–6 a median transverse chestnut line shortest on second and on sixth segments, and with anterior border of each mark emarginated; ventral surface of segment 5 with broad transverse chestnut blotch almost divided in the middle; segments 4 and 6 with such blotches completely and widely divided, making two lateral blotches on each segment; segment 3 with faint indications of such lateral blotches; genitalia confined to segments 7–8, side pieces angulated with points projecting inwards and slightly crossing each other at tips; posterior angles of abdominal segments with few long hairs; segment 8 with hairs rising from middle of margin; segment 9 with about twelve hairs along posterior margin which is broadly rounded.

Nirmus signatus Piaget. (Plate vi, fig. 5.)

Les Pediculines, 1880, p. 186, pl. xv, fig. 8.

Nirmus signatus Piaget, König, Ein Beitrag zur Mallophagenfauna, 1884, p. 10.

Three males and three females taken from an American Avocet, *Recurvirostra americana* (Lawrence, Kansas). Piaget found this species common on *Recurvirostra avocetta* (Zool. Garden of Rotterdam), and König found it abundant on the same bird species taken near Kiel.

As Piaget figures only the female, and the differences between the sexes in shape and markings of abdomen and character of last segments is considerable, I figure the male. The difference in size between the sexes is considerable, as shown by the following measurements of my specimens: Male, body, length 1.9 mm., width .5 mm.; head, length 5 mm., width .36 mm. Female, body, length 2.5 mm., width .62 mm.; head, length .56 mm., width .4 mm. The characteristic markings of the species, especially the large and sharply-defined signature, make it easily recognized.

Nirmus pileus Nitzsch. (Plate vi, fig. 6.)

Germar's Mag. Entomol., 1818, vol. iii, p. 291.

Nirmus pileus Nitzsch, Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 373; Giebel, Insecta Epizoa, 1874, p. 162; Piaget, Les Pediculines, 1880, p. 182, pl. xv, fig. 6.

A single specimen, female, taken from an American Avocet, *Recurvirostra americana* (Lawrence, Kansas). Nitzsch's and Piaget's specimens were taken on *Recurvirostra avocetta*. I figure the female, although Piaget's figure is excellent, for the convenience of American students. The measurements of the specimen are: Body, length 2.8 mm., width .78 mm.; head, length .62 mm., width .60 mm. These measurements vary a little from Piaget's, my specimen being shorter and wider, and the head a fifth greater in length and width.

Nirmus lineolatus Nitzsch. (Plate vi, figs. 7, 8 and 9.)

Zeitsch. f. ges. Naturwiss., 1866, vol. xxviii, p. 376 (ed. Giebel).

Nirmus ornatus Grube, v. Middendorff's sibir. Reise zool., vol. i, p. 477, pl. i, fig. 4.

Nirmus lineolatus Nitzsch, Burmeister, Handb. Entomol., 1838, vol. ii, p. 428; Giebel, Insecta Epizoa, 1874, p. 177; Piaget, Les Pediculines, 1880, p. 199.

I have taken this common *Nirmus* of the gulls from *Larus argentatus smithsonianus*, *brachyrhynchus*, *glaucescens*, *canus*, *vegæ*, *occidentalis*, *heermanni*, *californicus*, *delewarensis* (Bay of Monterey, California). Nitzsch found it on *Larus canus*, *argentatus*, *glaucus*, *tridactylus*, and Piaget on *argentatus* and *glaucus*. It is readily distinguishable by its characteristic head markings and by the ventral abdominal blotches and the genitalia of the male. The young, which I have found in many stages of growth, differ from the adult, especially in the shape of the head and the markings of the body.

Description of very young. Body white, with few brown markings. Head short, broadly conical; front rounded; temporal angles with a single long hair; front with two very short hairs on each side (invisible except under high magnification); antennæ rather short and thick, uncolored; mandibles pale brown; a small black ocular fleck; head otherwise uncolored. Thorax shaped as in adult, with but four long metathoracic hairs instead of six; prothorax unmarked; a small fleck at anterior angle of metathorax. Abdomen with sides subparallel; no medial markings; a small lateral marginal blotch on segments 1–7; segments 1–4 without hairs at posterior angles.

Lipeurus densus n. sp. (Plate vii, figs. 1 and 2.)

A single female specimen taken from a Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). The form is a well-marked member of the group *circumfasciata*. As indicated by the clypeus, the simple lateral bands of the abdomen, and the concave posterior margin of the metathorax, it somewhat resembles *heterogrammicus* taken by Nitzsch and Piaget on *Perdix cinerea*.

Description of female. Body, length 4.3 mm., width .81 mm.; white, strongly marked with dark brown and black; sides subparallel.

Head, length .94 mm., width .75 mm., sides nearly parallel; clypeus obtusely angulated in front; six hairs on each side of forehead, the anterior one longest; trabeculæ wanting; antennæ uncolored, second segment longest, as long as fourth and fifth together, first and third about equal in length, with a very few scattered short hairs; eye prominent, hemispherical; temporal margin with two minute hair prickles, no other hairs; occipital margin concave; a strong, dark brown band completely bordering forehead, and continuing, interrupted at antennary fossæ, along temporal margins almost to occipital angles.

Prothorax quadrangular, convex on metathorax; two separated hairs at occipital angles; a lateral marginal brown blotch bounded outwardly along its posterior half by a transparent edge. Metathorax with lateral margins concave, deepest before the middle; anterior angles obliquely truncate; posterior margin straight or feebly concave; three long, strong, hairs in the posterior angles, arising from an elliptical uncolored space; a large brown blotch in anterior angles, and a smaller one in posterior angles, also a narrow marginal band running full length of segment. Sternal markings consisting of a faint bordering of anterior coxal cavities, an intercoxal line between pro- and mesacoxæ, an obscure median semicircular blotch with convex margin posteriorly, and a rather broad lateral marginal band on metathorax. Fore legs short, coxæ narrowly separated and globular, femora wide, tarsi alone colored; middle and hind legs long, coxæ produced widely and separated; femora long and slender; femora and tibiæ with dorsal, elongate, dark brown markings; tarsi and claws pale brown; tibiæ with two long hairs and three short ones on outer margin.

Abdomen with sides of segments 1–7 parallel; sides of segments 8–10 tapering posteriorly, tenth segment bicuspidate; posterior angles of segments 1–4 without hairs, angles of segments 5–6 with one hair, of segment 7 with three hairs, segment 8 with one hair rising before the angle, segment 9 with two hairs, segment 10 with each posterior point bearing four hairs, two arising on margin and one each from dorsal and ventral surfaces; a strong broad, dark brown, marginal band, this band projecting in on segment 9 almost to median line; segment 10 wholly colored.

Lipeurus varius n. sp. (Plate vii, figs. 3 and 4.)

A common parasite of the Pacific Fulmars, *Fulmarus glacialis* vars. *glupischa* and *rodgersii*, being found by me on twenty-six out of thirty specimens of these Fulmars shot on the Bay of Monterey, California. This white and blotched species belongs to the *Lipeuri circumfasciati*, and shows some similarity of appearance to *tricolor* Piaget (Les Pediculines, p. 363, pl. xxx, fig. 4), taken from an Albatross. Although this parasite was found on nearly all the Fulmars shot, on none was it present in large numbers (as was its companion *Lipeurus celer*), and among all the specimens taken by me, perhaps one hundred in total number, there is not a male.

Description of female. Body, length 2.9 mm., width .62 mm.; white, with distinct dark brown markings, marginal on head and thorax, and as lateral blotches not reaching the margins on abdomen.

Head, length .6 mm., width .4 mm.; sides subparallel, front parabolic, with five marginal hairs on forehead, one of which is separated from the others and close to angle of antennary fossa, and a short hair on dorsal surface projecting beyond the margin between first two marginal hairs; trabeculæ wanting; temporal margins with a single short hair; eyes distinct, with a fine prickle on margin just behind them; occipital margin straight; head uncolored and pale smoky brown, with dark brown circumferential antennal bands and ocular blotches which extend backwards, paling, over temporal region; antennæ uncolored, first two segments about equal, third and fourth equal and shorter, and fifth slightly longer than third or fourth.

Prothorax nearly square, angles rounding, posterior ones slightly swollen; whitish, except even dark brown lateral border. Metathorax elongate, slightly widening posteriorly, anterior angles swollen, posterior margin straight, with four long hairs, not pustulated, in posterior angles; lateral margins unevenly bordered with black and dark brown, widest anteriorly; sternal blotch pale brown, anterior part elliptical, with a backward-projecting, long, slender, tapering process. Legs uncolored except for pale brown tarsi and claws.

Abdomen slightly widening to segment 6, and then more rapidly narrowing; white, with two lateral brown quadrangular blotches, fading inwardly, and each, except on segments 1 and 7–9, with uncolored stigmatal spot; these distinct and characteristic lateral blotches do not touch the lateral margin, the white marginal border varying from very narrow to one-half the width of the blotches, as in the specimen figured; ninth segment angularly emarginated with two hairs on each point.

I figure an immature specimen which is about one-half the size of an adult; it lacks entirely the abdominal markings, showing small portions, but intensely colored, of the thoracic and head markings. The presence of but one of the long metathoracic hairs is interesting, and the usual large head, characteristic of the immature stages, is noticeable.

Lipeuru celer n. sp. (Plate vii, figs. 5 and 6).

This large dark form was found in great numbers on all specimens except one of thirty Pacific Fulmars, *Fulmarus glacialis* vars. *glupischa* and *rodgersii* (Bay of Monterey, California), examined by me. It belongs to Taschenberg's group, *clypeati sutura indistincta*, and its most obvious resemblances are to *grandis* taken by Piaget on *Procellaria pelagica* in the Zoological Garden of Rotterdam. It is distinguished from *grandis* by the different form of the head, by lacking the occipital signature, by the presence of occipital bands, by the markedly different abdominal markings, by the different character of the last segment of the male, and by other less obvious characters. Its dark color and large size make it a conspicuous object on the birds.

Description of female. Length 3.37 mm., width .7 mm.; body everywhere brown, the accentuated markings black, sides of head, thorax and abdomen subparallel.

Head, length 7. mm., width .5 mm.; sides nearly parallel; clypeus narrowly rounded in front with six lateral short hairs of which four are located along the margin at nearly equal distances apart, one arising from the dorsal surface near the anterior marginal hair, and one near the antennæ; trabeculæ wanting; temporal margins weakly convex with one long hair; antennæ with segments 1–2 about equal in length, segment 3 but little shorter, segments 4–5 shorter and feebly colored; whole head chestnut brown; clypeal signature wide anteriorly, short, and acuminate posteriorly; the pronounced antennal bands projecting inward at their basal extremities; the irregular orbital blotches, the narrow temporal marginal bands, and the distinct occipital bands much expanded at occipital margin, black or strongly dark brown.

Prothorax short, quadrangular, slightly wider posteriorly; chestnut brown, paler in the middle; lateral borders black. Metathorax widest at posterior angles; brown; lateral margins broadly and irregularly bordered with black; four long hairs arising from an uncolored spot. Sternum almost completely brown, showing a broad long median blotch abruptly pointed behind, set off by narrow uncolored lines from the broad lateral bands. Legs with coxæ, femora and tibiæ dark brown; femora paler on inner side and at distal extremity; trochanters uncolored; tarsi pale brown.

Abdomen with sides nearly parallel; segment 8 narrower and segment 9 very narrow and short; segment 1 shorter than the nearly equal segments 2–7; all segments brown; segments 1–7 with a rather broad, black, lateral, marginal blotch, emarginated on inner face; these blotches touching at the sutures produce a continuous lateral band emarginated on each segment; segment 8 not distinctly blotched, but with narrow lateral black margin; segment 9 slightly emarginated, and with a brown blotch on each side; segment 1 especially, and segment 2 with an ill-defined median blotch of dark brown; the sutures between segments 2–7 showing except at lateral ends as uncolored lines; below, the lateral bands are narrower and not emarginated (or faintly on each segment); segment 1 with distinct median blotch, and segment 2 with a larger indistinct blotch; one or two hairs at posterior angles of segments; on segments 7–9 more hairs.

Male. Body, length 3.44 mm., width .59 mm.; head, length .72 mm., width 5. mm. Antennæ, first joint as long as all others combined, second next longest, third short with a dorsal angular projection at distal extremity, fifth slightly longer than fourth; first, fourth and fifth more colored than others. Abdominal segments with complete transverse dark brown bands, black at lateral margins, and with paler stigmatal spots; ninth segment very small and not emarginated.

Rudow (Zeitschr. f. ges. Naturwiss., 1870, vol. xxxv, pp. 121–137), describes several *Lipeuri* taken on *Procellaria*, and one, *nigricans*, is a form as dark as *celer*, but all of these species are small, *nigricans* being but 1.5 mm. long.

Lipeurus longipilus n. sp. (Plate vii, fig. 7.)

A few males and females taken from two specimens (out of ten shot) of the American Coot, *Fulica americana*

(Monterey, California). The species was not present on any one of five Coots taken at Lawrence, Kansas. A well-marked member of the group *clypeati sutura distincta.*

Description of the male. Body, length 2.4 mm., width .4 mm.; fuliginous with paler femora, antennæ, prothorax and posterior half of abdomen, and black marginal bands on head, thorax and abdomen.

Head, length .53 mm., width .35 mm.; elongate, conical, with narrowly parabolic front, four marginal hairs in front of suture and three behind it; temporal margins with one hair, occipital margin straight or feebly concave; no trabeculæ; eyes inconspicuous; antennæ, first segment short, second segment large, broadest at base, almost as long as third, fourth and fifth together, third deeply notched and with an acute claw-like extremity, fourth and fifth short, cylindrical and more strongly colored than other segments; signature shield-shaped, extending to front margin of head, pale-colored anteriorly, with indistinct transverse striæ parallel with anterior margin, dark brown behind, a distinct suture extending from posterior angle along the median line not quite to the anterior margin of signature; this suture also extending posteriorly almost to mandibles; antennal bands broad, dark and straight; temporal margins bordered with black, paling inwardly; an acorn-shaped occipital signature, apex forward.

Prothorax almost square, bare, with uniform lateral marginal black band, which bends inwardly at the posterior angle. Metathorax quadrangular, longer than broad; anterior angles diagonally truncate; a slight constriction behind the anterior angles; posterior margin straight, with three very long hairs and one shorter hair in each posterior angle; segment dark brown, with uneven lateral border of black, widest at constriction. Legs with dark colored coxæ and tibiæ, paler femora with darker markings.

Abdomen elongate, first segment much narrower than thorax at articulation, segments gradually widening to the fifth and narrowing from there to the ninth; segments 5–7 shorter than others; segments 1–2 with one hair at posterior angle, segment 3 with two hairs, and remaining segments with much longer hairs; distinct marginal black bands, with clear segmental spots; transversal dark brown bands, narrower on segments 5–7; ninth segment wholly colored and angularly emarginated, the points each with two short hairs.

Female. Body, length 2.65 mm., width .5 mm.; head, length, .55 mm., width .35 mm.; slightly larger than male; antennæ, second and fifth segments about equal, longest, third and fourth about equal; abdomen with segments gradually shortening from first backward through the seventh, eighth slightly longer, ninth deeply angularly emarginate, the two acute points without hairs; from the dorsal face of the eighth segment two very long hairs arise just inside of the black lateral band; all segments wholly colored except posterior half of the eighth; the transverse sutures uncolored, and indications of an uncolored median longitudinal line on segments 3–6; lateral marginal bands black, with clear stigmatal spots on inner margin.

Lipeurus picturatus n. sp. (Plate viii, figs. 1 and 2.)

Four specimens, all female, taken on two specimens of American Coot, *Fulica americana* (Monterey, California), out of ten shot. No specimens found on four Coots killed at Lawrence, Kansas. A finely-marked form, with indistinct suture.

Description of female. Body, length 2.1 mm., width .35 mm.; slender, parallel-sided, strongly marked with brown and black in regular blotches and bands.

Head, length .5 mm., width .32 mm.; elongate conical with narrowly rounding or parabolic front; a weakly projecting very obtuse angle at suture; six marginal hairs, of which four are grouped about this angle; trabeculæ small but distinct; temporal margins with one hair; occipital margin concave; antennæ uncolored; segments 1–4, beginning with 1, gradually shorter, fifth segment as long as second; signature broad, paler in front and with indistinct transverse striæ parallel with anterior margin, posterior margin concave, and with a broad, uncolored median line running from this border nearly to anterior margin; the signature is thus almost divided longitudinally; antennal bands black, extending anteriorly and fading into the paler color of the signature; temporal margins unevenly bordered with blackish, and bearing one hair; an acorn-shaped occipital signature indistinctly showing through from under surface.

Prothorax almost square, with posterior margin slightly angulated on the metathorax; clear smoky brown in middle, with black lateral borders expanded in anterior angles. Metathorax longer than broad, sides diverging slightly, anterior angles diagonally truncated with a distinct lateral angle; posterior margin straight; four hairs in posterior angle, three of which are in a clear space. Legs pale with smoky brown to black markings.

Abdomen slender, subparallel-sided, with single hairs at posterior angles, longer on posterior segments; segments 1–2 longest; others successively shorter; segment 9 deeply angularly emarginated, the points acute; first and ninth segments wholly colored; others, except segment 8 which has a curving, transverse band extending entirely across, with narrow marginal black bands, and two quadrangular smoky brown blotches separated from each other and from lateral band by uncolored spaces.

In an immature specimen (plate viii, fig. 2) of about same size as adults, the markings are less intensely colored, the occipital signature and precoxal lines of ventral surface showing through, and the segmental parts of the marginal abdominal bands distinct, so that each segment appears to have four blotches, the outer ones darker.

Lipeurus diversus n. sp. (Plate viii, figs. 3 and 4.)

Several specimens taken from the Black-vented Shearwater, *Puffinus opisthomelas* (Bay of Monterey, California). The species is very like, in outline and markings, Piaget's species *angusticeps* (Les Pediculines, p. 306, pl. xxv, fig. 4) from a *Thalassidroma leachi* (Zool. Garden of Rotterdam), but shows such marked difference in size and certain details that it must be looked on as a distinct species.

The measurements of the specimens are (following in parentheses are the corresponding dimensions of *angusticeps* as given by Piaget): Male, body, length 3.4 mm. (2.8 mm.), width .37 mm. (.30 mm.); head, length .7 mm. (.6 mm.), width .37 mm. (.28 mm.). Female, body, length 4.1 mm. (3.65 mm.), width .5 mm. (.46 mm.); head, length .72 mm. (.65 mm.), width .43 mm. (.37 mm.). The description of the species in general is that given for *angusticeps* differing as follows: Male, the posterior border of the signature angularly concave, not straight; the temporal margins with two short hairs instead of one; the antennal colored bands bending inwards at the clypeal suture and continuous with the internal bands which bound the oral fossa; the metathorax with five long hairs on posterior angles instead of two; the legs concolorous with the pale body color, not strongly colored; the last two segments of the abdomen not, as in *angusticeps*, with straight tapering sides bearing six short hairs and the last segment emarginated, but with convex margins with two or three rather long hairs, and the last segment very finely if at all emarginated. Female, the last segment of the abdomen not "*profondément entaillé*," but slightly and narrowly emarginated; also no median uncolored line on the first two segments.

Lipeurus limitatus n. sp. (Plate viii, figs. 5 and 6).

Three females taken from a Dark-bodied Shearwater, *Puffinus griseus* (Bay of Monterey, California). This species belongs to the group *clypeati sutura indistincta*, and is the first *Lipeurus* to be found on *Puffinus*.

Description of female. Body, length 2.75 mm., width .41 mm.; slender, parallel-sided, pale with light yellowish brown well defined markings.

Head, length .6 mm., width 4. mm.; elongate, conical, front rounded, with four short marginal hairs, one on dorsal surface between first and second marginal hairs, and one very short hair at antennal angle; trabeculæ wanting; temporal margins with one hair; occipital margin nearly straight; eyes inconspicuous; antennæ with second segment longest, first nearly as long, fifth slightly longer than either the third or fourth, which are equal, concolorous with the head or paler; whole head pale, yellowish brown, with darker marginal bands of forehead connected at front by paler striated clypeal band; a narrow, frontal margin of the clypeus transparent; the rest of the clypeus pale brown, hinder margin emarginated; a brown ocular blotch, and the temporal margins near the eyes feebly browner than head color.

Prothorax short, hexagonal, with latero-anterior margins short and hardly distinct from lateral margins; lateral margins narrowly darker colored than rest of segment; no hairs. Metathorax almost three times as long as prothorax; sides subparallel; hind margin feebly convex or slightly angulated on abdomen; with four long hairs and one short one in posterior angles, the short hair being next to the outermost hair; the lateral margins very narrowly darker edged along their hinder half. Legs concolorous with body, dorsally narrowly darker edged.

Abdomen slender elongate, subparallel-sided, growing slightly wider to segment 7, segments 8–10 tapering; segments 1–7 subequal in length, segment 8 half as long as segment 7, segment 9 shorter than segment 8; segment 10 obtusely two-pointed; very sparsely haired, segments 2–6 with one short hair on margin just in front of posterior angle; a square pale brown blotch on each side of segments 1–7, darker-edged outwardly, and separated by a distinct median uncolored line; blotches of segment 8 meeting, and the markings of segment 9 continuous.

Lipeurus constrictus n. sp. (Plate viii, figs. 7 and 8.)

Found on three out of six specimens of the Surf Scoter, *Oidemia perspicillata*, and on one out of six specimens of the White-winged Scoter, *Oidemia deglandi* (Bay of Monterey, California); also found on a specimen of *perspicillata* taken at Lawrence, Kansas (Kansas River, during migration). The new form belongs to the group *bisetosi*, and is distinguished from *squalidus*, the member of the group which the new form most resembles by the smaller size, by the narrow basal abdominal segments, and by the concave hinder margin of the clypeal signature. Many specimens, males, females and young were taken.

Description of the male. Body, length, 2.31 mm., width 5 mm.; general habitus of *squalidus*, but distinctly smaller and with waist-like narrow basal abdominal segments.

Head, length .53 mm., width .41 mm.; temporal margins with five very short stiff hairs or prickles and one longer hair; antennal bands most strongly marked at anterior end, ocular blotch dark brown, and temporal margin broadly banded with brown paling internally. Lateral bands of prothorax darkest at posterior angles. Metathorax with large, lateral, marginal, dark brown blotch in front of the middle, and margin behind the blotch dark brown; hairs seven, as in *squalidus*. Legs concolorous with body, tarsi and claws darker. First two abdominal segments much narrower than succeeding ones, segments 4–5 the widest; segments 3–6 with two hairs, a long one and a short one, at posterior angles; segment 9 feebly emarginated, thus obtusely two-pointed; segment 1 short, segments 2–3 longest and equal, segments 4–5 next longest and equal, segment 6 very short especially in middle, segments 7–8 equal; lateral marginal bands distinct, dark brown; within pale yellowish brown quadrangular blotches separated by uncolored median line on segments 2–4.

The female is larger; body, length 3.12 mm., width .66 mm.; head, length, .63 mm., width .5 mm.; first abdominal segments shorter, segments 2–7 about equal, segment 9 very slightly emarginated.

The young of this species, as probably of all *bisetosi*, show characteristic transparent, narrow, lateral, abdominal margins, and on segments 1–7 along the lateral third of the hinder margin of each segment a linear transparent space; no brown markings.

Lipeurus punctulatus of Rudow (Zeitsch. f. ges. Naturwiss., v. xxxvi, p. 137), from *Oidemia fusca* is probably an immature specimen of this species.

Lipeurus ferox Giebel. (Plate ix, figs. 1 and 2.)

Zeitsch. f. ges. Naturwiss., 1867, xxix, p. 195.

Pediculus diomedæ. Fabr. Ent. Syst., 1794, iv, p. 421.

Lipeurus diomedæ Dufour. Ann. Soc. Ent. France, 1834, iv, p. 669, figs. 1 and 2; Giglioli, Quart. Jour. Mic. Sci., 1864, iv, N. S., p. 19, plate i, b, figs. 1, 2.

Lipeurus pederiformis Dufour. Ann. Soc. Ent. France, 1834, iv, p. 676, pl. 26, fig. 4.

Lipeurus ferox Giebel. Insecta Epizoa, 1874, p. 235. Piaget, E. Les Pediculines, 1880, p. 333. Taschenberg, O., Die Mallophagen, 1882, p. 145, pl. v, figs. 1, 1a.

To this large and striking species may be attributed three specimens, one male and two females, taken from the Short-tailed Albatros, *Diomedea albatrus.* The male was taken from one bird, the two females from another; these two birds, both immature, were the only specimens of this bird species taken on the Bay of Monterey. The various descriptions of *ferox* by Giglioli, Giebel, and Taschenberg differ somewhat; Giebel had only a male before him; Taschenberg had in addition an immature female, and while Giglioli had both sexes his descriptions are incomplete.

Description of female. Body, length 9. mm., tapering from sixth abdominal segment abruptly to tip of abdomen, and gradually toward the head; strongly and distinctly marked with dark brown on both sides of the body for its whole length; a median uncolored line widest on head and on sixth abdominal segment; body nearly glabrous.

Head, length 2.1 mm., width 1.4 mm.; widest behind the eyes; margins of head in front of antennæ nearly straight and oblique; temporal margin feebly rounding; occipital margin weakly concave; clypeal suture distinct; clypeus convex in front, without hairs or bristles: at suture a slight rounded emargination, with one long hair, and behind it five short hairs, farther back one short hair, and in front of insertion of antennæ two short hairs; signature large, broadly triangular with rounded angles, front margin parallel with margin of clypeus; antennæ with first segment uncolored, the remaining four brown, segment 2 longest, segments 1 and 3 about equal, segment 5 shorter than segment 4, each segment with a few short hairs; angles of antennary fossæ not projecting; eyes prominent; temporal margin with a few very short bristles; head broadly margined, widest posteriorly, with dark brown; a dark brown band across the head immediately behind the clypeal signature.

Length of thorax 2.5 mm., width 1.9 mm.; prothorax forming a parallelogram a little wider than long, the angles weakly rounded; lateral borders dark brown, extending inward along the front and hind margins toward the middle, but not reaching it, leaving the middle third of the segment uncolored. Metathorax expanding posteriorly; lateral margins with some small, uneven, rounded projections about the middle; posterior margin slightly concave, angles acute; near each angle near the posterior margin a single pustulated hair, and a little further in seven long pustulated hairs grouped in a small, elliptical, uncolored space; the whole metathorax strongly brown except narrowly along the posterior margin and behind and at the sides of a central longitudinal brown quadrangle (the sternal blotch showing through). Legs strong, with elongate coxæ, very short thick tarsi, with short thick claws; everywhere dark brown, except at the basal and distal extremities of coxæ and femora and the tarsi; a few scattered hairs.

Abdomen, length 4.5 mm., width 2. mm.; widest at sixth segment, tapering sharply to posterior extremity; posterior lateral angles of one segment projecting over anterior lateral angles of succeeding segment; segment 1 shortest, segment 7 longest; color mostly dark brown, consisting of very dark lateral border and large transverse lateral blotches, those of segment 6 meeting at middle line, others not meeting; an uncolored, median, longitudinal line interrupted on segment 6; on ventral side transverse blotches continuous across all the segments; anterior and posterior margins of each segment narrowly uncolored; an ill-defined stigmatal uncolored spot on segments 2–7; segment 8 conical, much narrower than segment 7, and segment 9 very short and narrow, two-pointed, each point bearing two strong hairs; sparsely haired; posterior lateral angles of segment 1 with one hair, of segments 2–4 with two hairs, of segments 5–6 with three hairs, of segment 7 with four hairs; segment 8 with two strong hairs near anterior lateral angle, two shorter hairs on side and three separated, strong, pustulated hairs on each half of posterior margin.

The male specimen of *ferox* taken by me differs rather markedly in some respects from Taschenberg's careful description of the specimen in his hands. Indeed, it has been a question with me whether my specimens could fairly be attributed to this species.

Lipeurus forficulatus Nitzsch. (Plate ix, figs. 3, 4, 5 and 6.)

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1866, vol. xxviii, p. 386.

Lipeurus forficulatus Nitzsch, Giebel, Insecta Epizoa, 1874, p. 238; Taschenberg, Die Mallophagen, 1882, p. 157, pl. iv, figs. 6, 6a, 6b.

Taken from four of five specimens killed of the California Brown Pelican, *Pelecanus californicus* (Bay of Monterey, California), and on two White Pelicans, *Pelecanus erythrorhynchus* (Lawrence, Kansas), the parasites numerous on the birds. Nitzsch's specimens were taken from *Pelecanus onocrotalus* (locality?). My specimens show distinctly the short forked projection on the first segment of the antennæ of the male, the character noted by Taschenberg which distinguishes this species from the otherwise similar form *bifasciatus* Piaget, found on *Pelecanus crispus* (Zool. Garden of Rotterdam).

I figure both sexes, although Taschenberg's figure of the male is good. I figure also two stages of the young. The measurements of the specimens figured are as follows: Male, body, length 2.6 mm., width .62 mm.; head, length .52 mm., width .5 mm. Female, body, length 2.7 mm., width .9 mm.; head, length .56 mm., width .56 mm. Young female, body, length 2.28 mm., width .72 mm.; head, length .5 mm., width .48 mm. Very young, body, length 1. mm., width .44 mm.; head, length .375 mm., width .44 mm.

Lipeurus temporalis Nitzsch. (Plate x, fig. 1.)

Germar's Mag. Entomol., 1818, vol. iii, p. 292.

Ricinus mergi serrati De Geer, Mem. pour servir a l'hist. des Insectes, 1778, vol. vii, p. 78, pl. iv, fig. 13.

Pediculus mergi Fabricius, Species Insectorum, 1781, vol. ii, p. 480.

Lipeurus temporalis Nitzsch. Denny, Monograph. Anoplur. Brit., 1842, p. 175, pl. xiv, fig. 7; Giebel, Insecta Epizoa, 1874, p. 239; Piaget, Les Pediculines, 1880, p. 350, pl. xxxi, fig. 1.

Two females and a male taken from a Red-breasted Merganser, *Merganser serrator* (Bay of Monterey, California). The measurements of the female are: body, length 3.21 mm., width .9 mm.; head, length .7 mm., width .44 mm.

Male. Body, length 2.56 mm., width .5 mm.; head, length .66 mm., width .5 mm. Both Denny's and Piaget's figures are of the female. I figure the male.

Lipeurus testaceous Tschb. (Plate xi, figs. 2 and 4.)

Taschenberg, Die Mallophagen, 1882, p. 135, pl. v, fig. 3.

With some doubt I refer to this species five individuals taken from a Black-vented Shearwater, *Puffinus opisthomelas* (Bay of Monterey, California). Taschenberg's specimens, females only, were taken from *Procellaria capensis* (locality ?).

My adult specimens (three females) differ from Taschenberg's description in these details: the eye has a small hair not mentioned by Taschenberg; the front angles of the antennary fossæ are prolonged into small but distinct trabeculæ; there are five long hairs, not four, in the posterior angles of the metathorax, four hairs rising near together in a clear space and the fifth apart and near the lateral margin. I find distinctly in undoubted adult specimens the ten abdominal segments referred to by Taschenberg, who thought his specimens might be immature. The measurements agree well, those of the adult female figured by me being: body, length 2.50 mm., width .56 mm.; head, length .75 mm., width .53 mm. I figure an adult female and a very young.

Lipeurus toxoceros Nitzsch. (Plate x, figs. 3 and 5.)

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1866, vol. xxviii, p. 386.

Lipeurus toxoceros Nitzsch. Giebel, Insecta Epizoa, 1874, p. 237; Piaget, Les Pediculines, 1880, p. 343; Taschenberg, Die Mallophagen, 1882, p. 149, pl. iv, fig. 7.

Lipeurus gyroceros Nitzsch (ed. Giebel), Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 386.

An adult male and two young taken on two specimens of Farallone Shag, *Phalacrocorax dilophus albociliatus* (Bay of Monterey, California), and one adult male from a California Brown Pelican, *Pelecanus californicus* (Bay of Monterey, California). The pelicans and cormorants congregate in great numbers on the same rocks in Monterey Bay, and it is not surprising to find a straggling individual of this cormorant parasite on a pelican. Nitzsch's specimen was collected on a *Halieus carbo*, and the specimen described by Nitzsch as *gyroceros*, but declared by Taschenberg to be identical with *toxoceros*, was found on *Halicus braziliensis*.

The adult male figured by me measured as follows: body, length 3. mm., width .8 mm.; head, length .62 mm., width .6 mm.; and the young as follows: body, length 1.9 mm., width .53 mm.; head, length .5 mm., width .5 mm.

Lipeurus squalidus Nitzsch. (Plate x, figs. 6 and 7.)

Germar's Mag. Entomol., 1818, vol. iii, p. 292.

Pediculus anatis Fabricius, Systema Entomologiæ, 1775, p. 345.

Lipeurus squalidus Nitzsch. Gurlt, in Mag. f. d. ges. Thierheilk., 1842, vol. viii, p. 425; Denny, Monographia Anoplurorum Britanniæ, 1842, p. 176, pl. xiv, fig. 5; Grube, Middendorff's Reise, 1859, vol. ii, p. 486; Nitzsch (ed. Giebel), Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 385; Giebel, Insecta Epizoa, 1874, p. 241, pl. xvi, fig. 1; Piaget, Les Pediculines, 1880, p. 344, pl. xxx, fig. 5; Taschenberg, Die Mallophagen, 1882, p. 162.

This common species of the ducks has long been known, and is widely distributed geographically and zoologically. It has been taken on at least a dozen species of ducks, and what have been called varieties of it on still other species. The exact defining of *squalidus* has not yet been accomplished. Piaget declares that four resembling species (*sordidus*, *depuratus*, *frater* and *gracilis*) of Nitzsch and Giebel are simply *squalidus*; Taschenberg agrees with Piaget, and adds that Rudow's species, *rubromaculatus*, *punctulatus*, *cinereus* and *nyrocæ*, are, at best, but varieties of *squalidus*.

The evident truth is that the wide distribution of this duck parasite has resulted in the noting of the many variations normal to any animal species whose peculiar habits of life produce the comparative isolation of small groups of individuals. The common occurrence of the parasite and its hosts has resulted in its frequent capture, thus affording opportunity for the examination of many individuals widely separated geographically. It seems to me, under the circumstances, advisable to give a broad definition of the species, without attempting, as yet, to indicate varieties by name.

I attribute to this species specimens taken from a Bufflehead, *Charitonetta albeola*, Mallard, *Anas bosca*, and a Ruddy Duck, *Erismatura rubida*, all from Lawrence, Kansas. These specimens vary somewhat among each other, and all from the descriptions of Giebel and Piaget, which descriptions in turn do not agree with each other. The markings of the abdomen seem to be extremely variable, ranging from an indistinct lateral brownish coloration to distinct quadrangular, sharply-emarginated lateral blotches. More striking is the variation in number of the long hairs in the posterior angles of the metathorax. Piaget mentions two short ones, Giebel four, while all of my specimens show seven, varying in length and arranged as shown in figure 7, plate x. The specimen which I figure was taken from a Bufflehead, *Charitonetta albeola*, and will serve as a fairly representative illustration of the species for purposes of comparison. The measurements of this specimen are: body, length 3.3 mm., width .62 mm.; head, length .63 mm., width .44 mm.

Oncophorus advena n. sp. (Plate xi, figs. 1 and 2.)

A male and one female taken from the American Coot, *Fulica americana* (Bay of Monterey, California), and a male taken from a Pacific Loon, *Urinator pacificus* (Bay of Monterey, California). Can this last individual be a straggler? The female resembles the female of *Oncophorus minutus* Piaget, and was by me thought to belong to this species until I had found the male, whose appendaged antennæ make it impossible to refer the American specimens to this species. The female also on closer examination differs from the female *minutus* in its distinctly broader abdomen, by possessing four hairs on posterior angles and margin of metathorax instead of two, and by the absence of an uncolored median abdominal line. The new species by the character of the antennæ of the male belongs to the group *docophoroides.*

The genus *Oncophorus* was established by Rudow (Zeitschr. f. ges. Naturwiss., 1870, vol. xxxv, p. 175) for his *Oncophorus schillingi* since removed by Taschenberg to his genus *Eurymetopus.* Piaget has preserved the generic name *Oncophorus* but applies it to a group of widely removed *Nirmus*-like small forms. Eight species have been described, of which seven are found on wading birds. Piaget says of the genus that it serves as a natural transition between the genera *Docophorus* and *Nirmus* on one side, and *Goniodes* and *Lipeurus* on the other.

Description of the male. Body, length 1.15 mm., width .4 mm.; small, pale with dark brown lateral abdominal bands on all except last three abdominal segments.

Head, length .34 mm., width .32 mm.; front parabolic with a few short hairs rising from the dorsal surface on each side of the middle of the front projecting over the margin; trabeculæ short, wide at base appearing equilaterally triangular in shape; antennæ with first segment much enlarged, third segment with a distinct appendage, fourth shorter than fifth; eye at about middle of the head, flatly convex with a hair; temporal margins straight, diverging posteriorly with three short spiny hairs; in the posterior angles a very long strong hair, reaching to the posterior margin of the first abdominal segment; just behind this hair a spine, and on the occipital margin two short, strong, spiny hairs inserted even with the lateral margins of the prothorax; occipital margin sinuous; color, pale golden; antennal and ocular bands dark, subtranslucent and curving.

Prothorax, subquadrangular with anterior end projecting beneath the head, and anterior margin emarginated, posterior margin weakly convex; a long, strong hair in each posterior angle; pale golden, anterior angles darker. Metathorax not longer than prothorax, wider, with lateral angles rounded and with two long hairs inserted very closely together; on the posterior margin on each side two long hairs inserted very closely together; posterior margin convex and obtusely angulated on the abdomen; pale golden brown, with darker spots on anterior margin near the anterior angles. Legs concolorous with body, or slightly paler.

Abdomen short with subparallel sides, posterior angles projecting slightly, and with two or three rather long hairs; a double longitudinal line of weak hairs along dorsi-meson; lateral bands smoky brown fading out on posterior segments; last segment truncate behind, with a few very short inconspicuous hairs on posterior margin; genitalia distinct, with two backward projecting prongs and two longer forward projecting prongs reaching fourth segment.

Female, body, length 1.28 mm., width .5 mm.; head, length .4 mm., width .4 mm.; head less "square" in appearance, more tapering, temporal margins convex not straight; antennæ with second segment longest, third and fourth equal and fifth slightly longer than fourth; lateral bands of abdomen much more strongly marked and posterior angles of abdominal segments projecting more; last segment of abdomen rounding with slight emargination.

Eurymetopus taurus Nitzsch. (Plate xi, figs. 3, 4, 5 and 6.)

Zeitsch. f. ges. Naturwiss., 1866, vol. xxviii, p. 385 (ed. Giebel).

Philopterus brevis Dufour, Ann. d. l. Soc. Ent. France, 1835, vol. iv, p. 674, pl. xxxi, fig. 3.

Docophoroides brevis Giglioli, Quart. Jour. Mic. Science, 1846, vol. iv, p. 18, pl. i, B, figs. 3, 4.

Lipeurus taurus Nitzsch, Giebel, Insecta Epizoa, 1874, p. 234; Piaget, Les Pediculines, 1880, p. 332, pl. xxxi, fig. 3.

Eurymetopus taurus Nitzsch, Taschenberg, Die Mallophagen, 1882, p. 183, pl. v, figs. 8, 8a.

Many specimens, males, females and young, taken from two specimens of the Short-tailed Albatross, *Diomedea albatrus*, shot on the Bay of Monterey, California. Also found on two out of thirty specimens of the Pacific Fulmar, *Fulmarus glacialis* vars. *rodgersii* and *glupischa*, taken in the Bay of Monterey, California. This species has been found by Nitzsch, Swinhoe, Dufour and Meyer on *Diomedea nigripes*, *exulans* and *brachyura*. The specimens taken by me differ in some slight details from Taschenberg's careful description, notably in the longer and narrower signature and in their much smaller size, both males and females being less than three-fourths as large as the specimens (Nitzsch's) measured by Taschenberg, and about three-fourths the size of Piaget's specimens. The measurements of my figured specimens, as compared with Taschenberg's measurements, are as follows (Taschenberg's figures in parentheses): Male, body, length 3.12 mm. (4.13 mm.), width 1.18 mm. (1.75 mm.); head, length .9 mm. (1.25 mm.), width 1. mm. (1.52 mm.). Female, body, length 3.40 mm. (4.38 mm.), width 1.5 mm. (1.62 mm.); head, length .95 mm. (1.25 mm.), width 1. mm. (1.56 mm.). Taschenberg's figures are in bad shape; he evidently attributes to the male the measurements of the female and *vice versa*, as he makes the male the larger. In the above comparison I have transposed his figures. Also he attributes to the male (= female) a thorax almost twice as long as that of the female (= male)! This is an obvious error. Despite the conspicuous difference in size and a few other minor ones, I incline to attribute my specimens to Nitzsch's species rather than to call them new.

The blotches on the ventral side of the abdomen of the male, described by Piaget and said by Taschenberg to be wanting on his specimens, are plainly present in mine. As both Piaget and Taschenberg figure the male, I figure the female, the head of the male, and an immature male and immature female. This last shows an interesting stage in the formation of the lateral abdominal blotches, there being two blotches on the lateral portion of each segment, which fuse to form the large blotch of the adult stage. The short round abdomen and peculiar marking of the head are also striking. The measurements of the young female figured are: body, length 2.15 mm., width 1.25 mm.; head, length .65 mm., width .8 mm. The immature but nearly grown male is as large as the adults.

GIEBELIA gen. nov.

By this name (given in honor of Prof. C. G. Giebel) I would designate a *Docophorus*-like form of which several specimens (males and females) of a single species were taken from specimens of the Black-vented Shearwater, *Puffinus opisthomelas*. The distinguishing characters of the new genus are its *Docophorus*-like form, with very short, broad, suborbicular abdomen (in the single species yet known six-sevenths as broad as long); size of body and shape of abdomen same in both sizes; large head; produced rectangular anterior angles of temporal margins with the large eye in the angle; antennæ arising in an antennal emargination; conspicuous trabeculæ, a transparent, semilunar, transversal, membranous flap or process on the forehead with, in the male, a conspicuous, angulated, lateral lobe projecting over the lateral margin of the forehead about midway between the trabeculæ and the anterior angles of the clypeus, in the female barely produced beyond the margin; strong, obtusely toothed mandibles; labium with short but distinct apraglossæ with five short spines on tip of each; antennæ similar in both sexes; abdomen turbinated, with dark lateral bands and brown transverse bands.

Giebelia (nov. gen.) **mirabilis** n. sp. (Plate xi, figs. 7 and 8.)

Four males and five females taken from six out of seven individuals of the Black-vented Shearwater, *Puffinus opisthomelas*, shot on the Bay of Monterey, California. The only species of *Giebelia* yet found.

Description of the male. Body, length 1.28 mm., width .56 mm.; short, broad (abdomen six-sevenths as broad as long); pale ferrugineous with dark brown to black markings; abdomen with strongly colored lateral bands and paler transversal bands.

Head, length, .45 mm., width .45 mm.; front broad, truncate with very narrow uncolored margin; one short hair in anterior angle; on lateral margin in front of projecting transparent flap two short hairs; lateral projecting part of crescentic, transversal, transparent flap as long as from anterior margin of flap to anterior angle of clypeus; trabeculæ projecting as far as end of first segment of antennæ; antennæ rather long, slender, segments 1–2 about equal, longest, segment 2 shorter, segment 4 shortest, segment 5 almost as long as segment 2, all segments concolorous with head; sutures broadly uncolored; hind head broadly quadrangular; temporal margins subparallel with angulated anterior angles produced, and the large eye with a spine set at the angle; behind the eye a very short hair; farther back a short hair, and then two very long hairs; occipital margin straight, bare; four dark brown pointed papilla-like processes projecting upwards from dorsal surface of head, one at basal extremity of each antennal band, and one on each side in front of mandible; signature broad extending to mandibles; antennal bands dark brown, angulated, paler along lateral margins of clypeus in front of the flap; mandibles large and strongly colored, forming a broad dark brown transversal line connecting the antennal bands; occipital bands distinct, dark brown, diverging, black at base and biramose; suborbicular occipital signature with two short divergent posterior projections indistinctly showing through from under surface.

Prothorax short, broad; anterior angles, lateral margin and posterior angles rounded; a single hair at posterior angles; a broad, distinct, dark brown, lateral border. Metathorax broad, with angulated lateral margin, a pustulated hair and spine in each angle, and five more hairs, some pustulated and longer than the others, unevenly spaced along the lateral part of convex posterior margin; anterior portion of lateral margin with broad, distinct, dark brown border, with strongly colored process projecting posteriorly into the segment. Sternal markings composed of angulated intercoxal lines between meso- and meta-legs, and two small oblong spots darkest at posterior end on sternum between middle legs. Legs concolorous with body with narrow darker margins, tibiæ with three, short, strong spurs on distal extremity opposed to tarsal claws.

Abdomen short, broad, turbinated, with one or more hairs in each projecting posterior angle; a double row of short hairs down the middle of dorsal aspect; well defined, broad, black, lateral bands extending from segment 2 to segment 8, with uncolored stigmatal spots on inner margin of bands; a rather narrow, somewhat sinuous, brown, transverse bar extending across each segment from lateral band to lateral band; last segment with uncolored anterior angles and broad median blotch; rounded behind with a few short hairs; genitalia extending forward into segment 6, and with most distinct posterior portion (in last two segments) cordate.

Female, length 1.43 mm., width .62 mm.; head, length .5 mm. width .5 mm.; lateral portion of transparent lobe of forehead barely projecting over lateral margin of head; lateral bands of abdomen broadest anteriorly, narrow with inward projecting linear appendages on posterior segments; transverse bands darker in medial portion; last segment broad, flatly rounded.

Colpocephalum unciferum n. sp. (Plate xii, figs. 1, 2 and 3.)

Found on one out of five specimens of the California Brown Pelican, *Pelecanus californicus* (Bay of Monterey, California); and on one out of two specimens of the American White Pelican, *Pelecanus erythrorhynchus* (Lawrence, Kansas). This well marked species shows a resemblance to Giebel's (Nitzsch's) figure of *C. eucarenum* (Insecta Epizoa, pl. xiv, fig. 1), taken from *Pelecanus onocrotalus*, but Giebel's description (p. 276) is, if accurate, of some other species than that to which my specimens belong. Giebel affirms the head to be longer than broad, which is not the case with my specimens, and which would be, as Piaget says, characteristic. I cannot but make my specimens types of a new form.

Description of male. Body, length 2 mm., width .62 mm.; golden brown with dark brown abdominal bands and intense black head markings.

Head, length .44 mm., width .52 mm.; front very flatly convex, almost straight, with, on each side of middle line, a weak hair, a short thick pointed spine, a shorter hair, two longer hairs, a shorter hair, and in the expansion in front of the ocular emargination four rather stiff longish bristles, the second being the longest; palpi just projecting beyond the margin, and antennæ projecting by all of the last segment which is diagonally truncated; the eye is inconspicuous but double, the anterior half being the more prominent; in the ocular emargination several hairs, and a fringe of short thick-set hairs extending back to the middle of the temporal margin; on the temporal margin several prominent hairs, of which two are very long; occipital margin concave, bare; two large, black, occipital triangles extending forward, and paling and tapering rapidly, as occipital bands; a broad occipital black border connecting the triangles; large, black, ocular blotches, and an uneven, curving, dark brown, inner band, running from the ocular blotches to the frontal margin, the anterior end of these bands expanded and darker.

Prothorax short, angularly elliptical, with a series of seven hairs along each lateral half of the posterior margin, beginning with a short spiny hair in the apex of the lateral angle; whole segment pale golden brown, with a paler narrow transversal blotch in front of the middle. Metathorax short, broad, trapezoidal, lateral margin with short spiny hairs; color pale brown, darker laterally. Legs long, femora thickened, tibiæ slender, expanding distally, especially the tibiæ of the forelegs; tarsi one-half as long as tibiæ; color pale golden brown, with dark brown markings on dorsal aspect of femur and tibiæ.

Abdomen elongate, widest at fourth segment and gradually narrowing in both directions; ends of segments projecting on the sides and armed with stiff, sharp-pointed hairs, especially in posterior angles; segments 6–9 with a pair each of very long hairs; ninth segment broad and flatly rounded behind, posterior margin with several longish hairs; lateral ends of segments dark brown (dark region quadrangular) and a paler, transverse band running clear across each segment and covering all of its surface, paler in its median portion; sutures paler to uncolored.

Female, length 2.19 mm., width .62 mm.; abdomen rather fusiform in shape, segment 2 the widest; segment 9 elongate, tapering, with a series of six short, strong, recurved hooks on the front half of each lateral margin; posterior margin broadly obtusely angled and thickly beset with stiff hairs; from the middle of each lateral segmental margin arises a pair of long hairs; the lateral margins of the abdomen are darker, black in some specimens, than in the male.

An immature specimen, 1.56 mm. long, showed as its only markings the ocular blotches, the anterior ends of the inner bands and a short linear marking on occipital margin; all of these markings were distinct and black.

Colpocephalum uniforme n. sp. (Plate xii, fig. 4.)

A single female taken from an American Avocet, *Recurvirostra americana* (Lawrence, Kansas). This species closely resembles *grandiceps* Piaget (Les Pediculines, p. 558, pl. xlvi, fig. 7), taken on *Hæmatopus ostralegus*, but differs from it in the number and arrangement of the long hairs on the head, thorax and last abdominal segment, and in the markings.

Description of female. Body, length 2.34 mm., width .75 mm.; elongate, pale golden brown, with very little darker markings; the small ocular blotches, occipital margin, and narrow lateral margin of metathorax and abdomen black.

Head, length .4 mm., width .6 mm.; ocular emargination less deep than usual; front rounded, almost a semicircle, the contour being slightly irregular because of a small, medial, angled projection, and a shallow almost imperceptible concavity behind the slight but distinct, obtuse, anterior angles; four hairs between the medial frontal angle and the latero-anterior angle of which the last hair is the longest, a very short hair in the anterior angle and a hair just in front of the projecting palpus tip; four hairs, of which one is long, in the lateral angle in front of the ocular emargination; the eye large with a slight emargination, the front half projecting further than the posterior half; the hairs of the ocular fringe larger than usual, the fringe extending but slightly on the margin of the broad temporal region; temporal margin with three long hairs and several short ones; occipital margin concave, bare. Color of head pale golden brown, with small black ocular blotches and narrow black border on outer temporal and occipital margins; indistinct narrow brown occipital bands, the black occipital margin expanded at their bases.

Prothorax with a spine and long hair in produced lateral angles, and a number of long hairs in obtuse latero-posterior angles; the posterior margin seems to be bare; golden brown with small latero-anterior dark brown blotches and very narrow dark brown border between lateral and latero-posterior angles. Metathorax showing no marginal constriction at line of union of meso- and metathorax; sides bare; produced posterior angles with two long hairs and two stout spines; posterior margin straight, bare; whitish, with narrow dark brown to black lateral border expanded slightly in anterior angles. Legs concolorous with body with very narrow dark brown dorsal margins of femora.

Abdomen elongate with long hairs in posterior angle of segments, and short hairs along lateral margins; a narrow interrupted (by sutures) black marginal band, and faint golden brown, broad, transverse bands darker on posterior segments; last segment slowly tapering, broad and flatly convex behind, with transparent margin and fringe of fine sharp-pointed hairs.

The specimen is probably not adult, and the markings consequently less extensive than those of the adults.

Colpocephalum pingue n. sp. (Plate xii, fig. 5.)

Two males taken from one of the two specimens of the Short-tailed Albatross, *Diomedea albatrus*, shot on the Bay of Monterey, California. No *Colpocephalum* has hitherto been taken on an Albatross.

Description of male. Body, length 1.7 mm., width .62 mm.; short, broad, fuscous, with dark brown abdominal transverse bands, paler medially.

Head, length .28 mm., width .5 mm.; but little more than half as long as wide; front flatly rounding, with, on each side of the middle which is marked by a minute angular process, a short weak hair, a longer stiff spiny hair, then another similar one (adjacent to the projecting palpus), and on the lateral angle in front of the ocular emargination four hairs, of which two are the longest of the forehead hairs; the palpus and antenna projecting beyond margin, each by its last segment; the eye large, simple, filling the base of the ocular emargination and containing a distinct, divided, black fleck; the ocular fringe of hairs extending only to the posterior limit of the emargination; the temporal margin convex and with eight hairs of which three are long; occipital margin weakly concave with two hairs on each side of the middle. Color of head fuscous with a narrow black occipital margin expanded at the bases of the faintly discernible occipital bands; the ocular blotches large, black, extending along the posterior margin of the emargination as a narrow black border, and still more narrowly and unevenly margining the temporal region; the inner bands indistinct, chestnut brown.

Prothorax broad (three-fourths as broad as head), short, posterior border rounded with a series of seven strong hairs beginning in the apex of the lateral angle; color pale yellowish brown. Metathorax short, broad, expanding rapidly posteriorly, anterior angles rounded, posterior angles produced, acute, with a short spine and a strong, long hair which is the terminal one of a series ranged along the straight posterior margin of the segment; sides bare. Color of prothorax light brown with a narrow dark brown or black uneven marginal blotch and a broad and transverse band of fuscous. Legs concolorous with body, with dark fuscous markings.

Abdomen broadly ovate, posterior angles of segments slightly projecting with one or two strong hairs and adjacent short ones; a series of strong hairs along posterior margin of each segment, and numerous other shorter hairs; each segment except last with a lateral marginal curving black blotch produced inwardly; also a transverse fuscous band extending entirely across each segment paler medially and darker on segments 7 and 8; ninth segment large, broad, rounded behind, posterior margin with two pairs of strong hairs on each side of the middle, whole segment uniformly fuscous.

Colpocephalum timidum n. sp. (Plate xii, fig. 6.)

Two females from a Golden Plover, *Charadrius dominicus* Lawrence, Kansas. The new species resembles *ochraceum* Nitzsch (Germar's Mag. Entomol., 1818, vol. iii, p. 299), somewhat.

Description of female. Body, length 1.94 mm., width

.37 mm.; pale brown, with small black markings on head and thorax, and dark brown markings on abdomen.

Head, length .36 mm., width .53 mm.; palpi not projecting, antennæ slightly projecting; front bare; lateral margin in front of ocular depression with four hairs of which one is long; eye with slight but distinct emargination; ocular fringe distinct; temporal margin with four long hairs, of which one, the third, is very long, and a few short hairs; occipital margin concave; pale yellowish brown, with small dark brown to black ocular blotches, and narrow occipital border expanded at bases of the very faint occipital bands.

Prothorax, with spine and hair on lateral angles, and close to the angle on latero-posterior border a hair; in latero-posterior angles a single hair, and along rounded posterior margin two very short hairs and two longer ones; without dark markings, although the lateral angles and borders appear darker because of sternal markings showing through; also the median sternal blotch faintly showing through. Metathorax with angular emargination on sides showing line of fusion of meso- and metathorax; anterior angles rounded; sides bare; posterior angles with a spine and two strong hairs; anterior angles bordered with black; lateral margins unevenly bordered with brown in which there is on each side a short linear black mark cutting off the region of the posterior angles. Sternal markings consisting of a median blotch on prothorax, a paler and more indistinct large median blotch on metathorax, and dark intercoxal lines. Legs concolorous with body; all femora thickened.

Abdomen, nowhere strongly colored or marked; an uncolored longitudinal line running parallel with each lateral margin on segments 1–8; outside of this line on each segment an ill-defined fuscous blotch showing as its most distinct portion a short transverse line, especially noticeable on segments 1–6; the posterior angles of the segments, which hardly project, bear each a long hair, a very few scattered small hairs on lateral margin; numerous short non-pustulated hairs scattered over the surface of the body; last segment pale with two longish lateral marginal hairs, and convex behind with a short fringe of fine transparent hairs.

Colpocephalum funebre n. sp. (Plate xii, fig. 7).

Two females from two specimens of the Glaucous-winged Gull, *Larus glaucescens*, Bay of Monterey, California. This species resembles *fuscipes*.

Description of female. Body, length 3.1 mm., width 1.5 mm.; large with comparatively small head and thorax; dark brown, with black markings.

Head, length 5 mm., width .78 mm.; palpus barely or not at all projecting beyond margin of forehead; antenna projecting slightly; front flatly rounded with eleven hairs on each side between middle of front and ocular emargination, of those on the true front the second and fifth longer than the others and of those on the side one very long; ocular emargination deep, narrow; eye large, simple, hemispherical, the ocular fringe prominent; of the hairs on the temporal margin four are long; occipital margin not deeply concave, bare; color dark brown with a narrow black border extending more or less distinctly entirely around the head; on the sides of the forehead the border is broken into spots, and along the front it is sinuate and is narrowly margined in front by a pale, almost uncolored space; on each lateral region of the forehead there are three small circular uncolored spots from each of which arises a short hair; on under side of head, a distinct large occipital signature; narrow occipital bands bending outward anteriorly, and a narrow black line bounding the oral fossa.

Prothorax, narrow, short; lateral angles obtuse, produced, and with a spine and long hair; in latero-posterior angle a long hair, and in addition two posterior marginal hairs on each side of the middle; color dark brown with narrow black lateral border, and a very narrow transverse line across the segment in front of the middle. Metathorax, sides bare, posterior angles with two spines and a long hair; posterior margin with a few hairs; color dark brown with darker irregular broad lateral border and large trapezoidal median blotch (sternal marking showing through) limited to metathorax; a distinct paler-colored sutural line between meso- and metathorax, with slight angular emargination on the sides; mesothorax with a paler-colored narrow median line separating the dark quadrangular lateral blotches. Sternal markings consisting of a median irregularly octagonal blotch on prothorax, behind it a Y-shaped line running across mesothorax and connecting with a large pentagonal metathoracic blotch with apex directed anteriorly; in addition broad lateral and coxal borders. Legs long, fore femora greatly thickened, middle femora not so much so and hind femora but little thickened; with scattered prominent hairs; concolorous with body.

Abdomen, very large, elongate oval, with one long hair in posterior angles of segments and several short ones along sides and in angles; a series of about twenty pustulated hairs along posterior margin of segments 1–7; these series extending laterally only to a pale-colored longitudinal line running parallel with the lateral margin of body and about .16 mm. from it. Color dark brown, with narrow black lateral border interrupted by sutures; and extending in on each segment along posterior margins to the pale longitudinal line, and along anterior margin not quite to this line; broad transverse bands extending across each segment between the pale longitudinal lines; last segment with three blotches and rounded, hair-fringed posterior border.

Colpocephalum laticeps n. sp. (Plate xii, fig. 8.)

A single male specimen from an American Egret, *Ardea egretta* (Lawrence, Kansas). This small and well-marked species cannot be referred to any one of the *Colpocephali* described by Nitzsch from various species of *Ardea*.

Description of male. Body, length 1.72 mm., width .72 mm.; dark golden brown, abdomen with distinct dark fuscous transverse bands.

Head, length .31 mm., width .62 mm.; just twice as wide as long; front broadly rounded with hairs on each side of the middle, as follows: a very short one, another and another, all some distance apart, and in the lateral angle in front of the ocular emargination four, of which two are long; the eye undivided but with a faint medial emargination and with a single black fleck in it; the ocular fringe not extending on the temporal margin; this margin with several short, fine, stiff hairs and three unevenly long pustulated ones; also a long pustulated hair arising from nearly the center of the temporal region; occipital margin not deeply concave, with four hairs; color pale smoky brown, ocular blotch black, bordered irregularly with dark smoky brown which extends backwards as an indication of occipital bands and forward as a suggestion of inner bands; temporal margin narrowly bordered with blackish brown; occipital margin narrowly bordered with black, widest along middle third of head.

Prothorax comparatively long and narrow (the width is always greater than the length among the *Colpocephali*), with conspicuously obtusely produced lateral angles bearing a spine and a long hair; the lateral margin between this lateral angle and the rounded posterior angle slightly concave and bare; posterior angle with a long hair followed by a short stiff hair, and by three long pustulated hairs along each half of the posterior margin; color fuscous with a darker, narrow, transverse line before the middle, and two similarly colored, narrow, curving lines running subparallel with the lateral margins. Metathorax trapezoidal, with posterior angles projecting beyond the sides of the abdomen; these angles with some short stiff hairs and the first of a series of ten long hairs ranged along the posterior margin; lateral margins bare and with a slight constriction in front of the middle indicating the line of fusion of meso- and metathorax; color fuscous with darker, almost black, triangular blotch in posterior angles, and a rather broad, pale, almost uncolored transverse line at line of fusion of meso- and metathorax.

Abdomen rather broadly elliptical with projecting ends of segments; one long and several shorter hairs on each posterior angle, and a series of about twelve hairs along the posterior margin of each segment. Color pale at sutures, black interrupted (by sutures) lateral bands, and a dark brown transverse band extending entirely across each segment; ninth segment broadly rounded behind with narrow transparent margin thickly set with a fringe of short sharp-pointed transparent hairs.

Ancistrona gigas Piaget. (Plate xiii, figs. 1 and 2.)

Les Pediculines, Supplement, 1885, p. 117, pl. xii, fig. 8.

Several specimens, ♂, ♀ and ⊙, of this remarkable form from four individuals of the Pacific Fulmar, *Fulmarus glacialis* vars. *rodgersii* and *glupischa* (Bay of Monterey, California). Piaget described the species from a single female taken from *Procellaria glacialis.* His description is excellent. The males differ from the females very little, the recognizable character being the hairless condition of the posterior border of the last abdominal segment. On each lateral margin of this segment there is a small group of short uncolored hairs, rather thick at base. I figure the male and an immature specimen. The immature specimen is without markings, except for a black fleck in the posterior angle of head, and a weak indication of the prothoracic lines. The head and thorax are of pale brownish, the abdomen whitish tinged with buffy. The measurements of the specimens figured are as follows: Male, body, length 5.5 mm., width 2.65 mm.; head, length .7 mm., width 1.87 mm. Young, body, length 2.6 mm., width 1.2 mm.; head, length .5 mm., width 1. mm.

Trinoton lituratum Nitzsch. (Plate xiii, fig. 3.)

Germar's Mag. Entomol., 1818, vol. iii, p. 300.

Trinotum lituratum Nitzsch, Burmeister, Handbuch d. Entomologie, vol. ii, p. 441; Giebel, Insecta Epizoa, 1874, p. 260, pl. xviii, fig. 10.

Trinoton squalidum Denny, Monograph. Anoplur. Brit., 1842, p. 235, pl. xxii, fig. 3; Giebel, Insecta Epizoa, 1874, p. 259.

Trinoton lituratum Nitzsch, Piaget, Les Pediculines, 1880, p. 597, pl. xlix, fig. 7.

A few specimens taken from the Pintail, *Dafila acuta*, and the Buff-breasted Merganser, *Merganser serrator* (Lawrence, Kansas). Nitzsch's original specimen was found on *Mergus albellus*, and Denny's specimens were taken from *Anas clypeata.* Piaget found the species on *Dendrocygna arborea* and *Anser albifrons* (Zool. Garden of Rotterdam). The species is easily recognized by its short broad outline and its markings. The female figured by me measured as follows: body, length 2.1 mm., width .63 mm.; head, length .5 mm., width .63 mm.

Trinoton luridum Nitzsch. (Plate xiii, fig. 4.)

Germar's Mag. Entomol., 1818, vol. iii, p. 300.

(Louse of the Teal) Redi, Experimenta circa gen. Insectorum, 1686, pl. xii (or x?); Albin, Nat. Hist. of Spiders and other curious insects, 1736, pl. 46 (or 48?).

Trinotum luridum Nitzsch. Burmeister, Handbuch. d. Entomologie, vol. ii, p. 441; Giebel, Insecta Epizoa, 1874, p. 258, pl. xviii, fig. 7.

Trinoton luridum Nitzsch. Denny, Monograph. Anoplur. Brit., 1842, p. 234, pl. xxii, fig. 2; Piaget, Les Pediculines, 1880, p. 591, pl. xlix, fig. 3.

Trinoton gracile Grube. Middendorff's Reise, vol. i, p. 494, pl. ii, figs. 6 and 6a.

Trinoton conspurcatum Nitzsch. Gurlt, in Mag. f. d. ges. Thierheilk., vol. viii, p. 430, pl. iv, fig. 15.

I have taken this common parasite of ducks from the Shoveler, *Spatula clypeata*, the Buff-breasted Merganser, *Merganser serrator*, the Greenwinged Teal, *Anas carolinensis*, the Pintail, *Dafila acuta*, the Mallard, *Anas boscas*, the Widgeon, *Anas americana* (Lawrence, Kansas), and from the Ruddy duck, *Erismatura rubida* (Monterey, California). There is, as has already been said by Piaget, a considerable variation in the individuals of this species, especially in the extent and intensity of the abdominal markings. It seems hardly worth while in the present state of knowledge of the Mallophaga to attempt to indicate these varietal differences by name. The size varies somewhat markedly among individuals and the males are smaller than the females. The following are the measurements of two specimens, one a male taken from a Pintail, *Dafila acuta* (Lawrence, Kansas), and the other, whose measurements are enclosed in parentheses, a female (the specimen figured by me) taken from a Ruddy Duck, *Erismatura rubida* (Monterey, California): Body, length 4.3 mm. (5. mm.), width 1.19 mm. (1.56 mm.); head, length .7 mm. (.8 mm.), width 1. mm. (1.28 mm.).

An immature specimen taken from a Greenwinged Teal, *Anas carolinensis* (Lawrence, Kansas), is almost as large as the average adult, but is uniformly pale, faintly tinged with clear brownish, showing no markings except a distinct black ocular fleck and the brown mandibles. The dimensions of this specimen are: Body, length 4.5 mm., width 1.43 mm.; head, length .81 mm., width 1.28 mm.

Læmobothrium similis n. sp. (Plate xiv, figs. 1 and 2.)

A single specimen from an Eared Grebe, *Colymbus nigricollis californicus* (Lawrence, Kansas). This species is very like Piaget's *emarginatum* (Les Pediculines, 1880, p. 585, pl. xlviii, fig. 8), taken from *Gallinula hæmatopus* (Zool. Garden of Rotterdam), but lacks the occipital bands of the head, has more of the peculiar, short, flattened, stiff points on the front margin of the head, has a very differently shaped prothorax (if Piaget's desription and figure are accurate), lacks the strong markings of emargination, and is a slightly larger species. My specimen is probably not adult, but is of not earlier stage than the last nymphal one. Adult specimens will measure a little larger, and will be a little more strongly marked. This genus has not before been found on a pygopodous bird.

Female, body, length 4.4 mm., width .87 mm.; uncolored (weakly pale brownish) with narrow, sharp, brown markings on head and thorax.

Head, length 1. mm., width .78 mm.; ocular emargination slight, contraction of sides of head even with the mandibles strong, sides of forehead slightly converging; front with rounding emargination, angles rounding; on each side of the center of the emargination toward the angle are a short hair, a longer hair arising from ventral surface, two short flattened spines, and projecting over the margin between them a hair arising from the dorsal surface, a long hair, a very short weak hair, and beyond the apex of the angle two flattened spines, the second one longer, and a long hair; the front half of the convex margin of the antennal fossa bears one very long hair and four shorter hairs, and the hinder half three weak, equal hairs arising close together and projecting backwards; the temporal margins bear two long hairs and more than a dozen short, equal ones; occipital margin concave; eyes double, inconspicuous; antennæ concealed in fossæ but showing through, fourth segment subglobular; labial palpi, with thick segments of about equal length, third and fourth segments with a short hair at anterior outward angle; mandibles pale brown with teeth dark brown; ocular flecks black; antennal fossæ rimmed with brown and a curved band, convex behind, across the head between middle points of antennary fossæ; a narrow, long, pale brown triangle projecting back from middle of transverse curving band just described; no occipital bands; in front of mandibles a rounding, pointed, crescent-shaped fossa, convex anteriorly.

Prothorax, subquadrangular, with a narrow anterior neck-like portion which fits into the occipital concavity of the head, sharply set off by a constriction; the posterior margin deeply and broadly emarginate, leaving the posterior angles as obtusely pointed, backward projecting processes underlying the metathorax; behind the frontal constriction the margin is angulated and a long hair and a short one rise from the angle; two black flecks on the frontal margin, a black fleck on each side of the constriction, and a brown lateral marking extending a little way along the middle of the margin. Metathorax and mesothorax continuous in outline with the abdomen; mesothorax indicated by a very slight narrowing near the front of the combined segments; three longer hairs and seven short ones along the margin of the segment; two brown flecks on front margin, and the rounding anterior angles narrowly and weakly margined with brown. Legs, uncolored, except for pale brown at extremities of segments, and very narrow marginal lines; front margins of femora of middle and hind legs with four or five subequal prominent hairs and several very short ones.

Abdomen, parallel-sided for anterior half and then gradually tapering posteriorly; no marginal constrictions between segments; but one or two long hairs in each posterior angle; last segment with one strong long hair and one longer, weaker hair in each posterior angle and a series of six short, equal hairs along posterior margin; margin narrowly lined with pale, clear brownish, and within a parallel, narrow, uncolored line.

Læmobothrium atrum Nitzsch. (Plate xiv, fig. 3.)

Germar's Mag. Entomol., 1818, vol. iii, p. 302.

Pulex fulicæ Redi, Experimenta circa generationem Insectorum, 1686, pl. iv, fig. 1.

Læmobothrium nigrum Burmeister, Handbuch d. Entomologie, 1832, vol. ii, p. 442.

Læmobothrium atrum Nitzsch, Denny, Monograph. Anoplur. Brit., 1842, p. 240; Giebel, Insecta Epizoa, 1874, p. 253, pl. xviii, fig. 5; Piaget, Les Pediculines, p. 586.

A single specimen from an American Coot, *Fulica americana* (Monterey, California). The previously taken specimens have been found on *Fulica atra*, also probably one occurrence on *Podiceps rubricollis*. The descriptions vary somewhat and are incomplete, and Giebel's figure shows strange markings of head and thorax, but the large size and dark coloration of the entire body sufficiently identify the species. Giebel's measurements are far under those of my specimen, which are: body, length 8 mm., width 1.9 mm.; head, length 1.4 mm., width 1.17 mm.

Menopon navigans n. sp. (Plate xiv, figs. 4 and 5.)

Two males and a young female taken from a Short-tailed Albatross, *Diomedea albatrus* (Bay of Monterey, California). Piaget has found a *Menopon (affine*, Tijdschr. voor Ent., 1890, vol. xxxiii, p. 248, pl. x, fig. 3) on an Albatross *(Diomedea exulans*, a skin in the Leyden Museum), but my new species does not resemble *affine* particularly. *Affine* is a smaller species, with a head more than three-fifths as long as broad; the head of the new species is twice as wide as long.

Description of the male. Body, length 1.8 mm., width .75 mm.; head and thorax pale with dark brown markings; abdomen with large, brown, transverse bands, sub-parallel-sided; many long bending hairs.

Head, length .34 mm., width .66 mm.; semilunar, front with, on each side, three hairs (of which the second is not strictly marginal), then a very short prickle, then five hairs in front of the ocular region, of which three are long; palpi and antennæ projecting by the length of their terminal segments; temporal margin with two very long hairs, one half as long, two one-fourth as long, and a few short ones; occipital margin concave with four hairs on the middle third. Color, pale brown, darker medially, and with black ocular blotches, and a linear, black, occipital border.

Prothorax broad, short, with lateral angles much produced and bearing two long hairs and a spine; posterior margin flatly convex with ten hairs; color pale with a brown transverse line and brown lateral angles darkest outwardly, the margin of the latero-posterior sides being black. Metathorax short, as broad as prothorax, pentagonal, posterior margin straight with a series of hairs closely set, anterior angles and lateral borders expanding in posterior angles, black; a broad transverse brown band like those of abdomen, in front of which a narrow whitish space broadest medially. Legs concolorous with pale ground color of body, with hairs and thickened femora.

Abdomen oblong, with convex sides and ends, all the segments except 9 being of approximately equal width; especially long hairs in posterior angles and shorter hairs on surface; each segment except 9 with broad transverse brown band covering nearly whole surface of segment and darkest along posterior margin; lateral extremities of bands dark brown to black, forming narrow interrupted lateral bands; segment 9 wholly colored, paler than transverse bands, large, rounding with numerous long hairs.

Menopon indistinctum n. sp. Plate xiv, figs. 6 and 7.)

Two females taken from an American Avocet, *Recurvirostra americana* (Lawrence, Kansas). This species most clearly resemble *crocatum* Nitzsch (ed. Geibel, Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 392), from a *Numenius arquata* and *Hæmatopus ostralegus* (Piaget), but there are differences quite as considerable as those which have been used by Giebel and Piaget to separate the various *Menopon* species found on the shore birds. *Crocatum*, *lutescens et. al.* ought, perhaps, to be grouped together as a single species with several varieties, as is done for *Docophorus communis*, the common *Docophorus* of the passerine birds. However I add this species from our Avocet to the group which must sometime be well revised. The noticeable differences between this new species and *crocatum* lie in the number and disposition of the hairs of the head and thorax. The species does not at all resemble Nitzsch's species from the European Avocet, *Recurvirostra avocetta (micrandum*, Zeitschr. f. ges. Naturwiss. ed. Giebel, 1866, vol. xxviii, p. 392), which has a thorax without hairs, and an abdomen with uncolored longitudinal lines.

Description of female. Body, length 1.80 mm., width .7 mm.

Head, length .28 mm., width .5 mm.; semilunar; twice as wide as long, front with two short hairs at the middle, and on each side in front of the ocular region two short hairs and a long one; palpi slightly projecting; ocular margin straight or very faintly concave; temporal margin with four long pustulated hairs and several short ones; occipital margin concave with one long pustulated hair on each side; head golden brown with fuscous clouding, occipital margin and ocular fleck black; curving line bounding inwardly the antennal region black inwardly shading into dark brown outwardly; a transversal line even with the mandibles and expanded at outer ends, dark brown.

Prothorax, seven-eighths as broad as head, lateral angles very obtusely rounded, almost truncate, with two spines and a long hair; behind the angle on latero-posterior side a spine, then two hairs, and on the straight posterior margin three hairs on each side of the middle; color smoky brown with a distinct transverse darker line in front of the middle and not reaching the lateral margins; outside of each end of this line a short, slightly curving, longitudinal, dark line; the latero-posterior sides narrowly edged with black. Metathorax just as wide as head, narrow anteriorly with rapidly diverging sides, mesothorax distinctly separated by marginal constriction and dark transverse line; posterior angles of mesothorax bare, sides of meso- and metathorax bare; posterior angles of metathorax with a spine and the terminal one of a series of hairs ranged thickly along the weakly convex posterior margin; metathorax with a broad, transverse, fuscous band across posterior half. Sternal markings composed of small median blotch on prothorax with lateral linear processes; a small pointed blotch with two diverging very small linear processes projecting anteriorly, the whole between strongly curving, inwardly produced intercoxal lines, on mesothorax; and a larger median blotch, truncate behind, convex before, with two small linear points near the posterior angles of median blotch, on metathorax; a smaller semilunar median blotch on first segment of abdomen is also apparaent; the blotches of metathorax and first abdominal segment are beset with numerous short pustulated hairs. Legs pale smoky brown, with darker markings.

Abdomen, elongate oval, posterior angles of segments 1–3 projecting a little; the others barely or not at all; a rather long hair and some shorter ones in each angle; also a series of hairs in small pustulations along the posterior margin of each segment; all segments with a broad, distinct, light fuscous, transverse band whose extreme outer margins are darker; the bands separated by wide, uncolored, sutural lines; last segment, broad, short, uncolored, posterior margin concave with a series of fine short hairs.

Menopon numerosum n. sp. (Plate xv, fig. 1.)

An abundant parasite of the Pacific Fulmars, *Fulmarus glacialis* vars. *glupischa* and *rodgersii*, taken on twenty-four out of thirty specimens shot on the Bay of Monterey, California.

Description of male. Body, length 1.44 mm., width .62 mm.; pale yellowish to reddish brown, with transverse abdominal bands, separated by broad, white, sutural bands.

Head, length .28 mm., width .50 mm.; front very obtusely but distinctly angled with two short hairs on each side of the median angle; three long hairs and three short ones before the slight ocular emargination; a sparsely set ocular fringe of short stiff hairs, and in the temporal angles four long hairs and several short ones; occipital margin broadly and shallowly concave and with four hairs; dark brown ocular blotches, distinct black flecks in the eyes, and a narrow, dark brown, occipital border.

Prothorax with posterior margin broadly and evenly rounded with fourteen long hairs in a series extending from lateral angle to lateral angle; a narrow transverse line in front of the middle and a short longitudinal line at each end of the transverse line; the lateral angle regions slightly darker than rest of segment. Metathorax with diverging sides, straight or very flatly convex posterior margin; along the sides three short spines, of which the first two project upwards and the third outwards beyond the margin; in the posterior angles are two long hairs, then a short spine, and then a series of twelve long, strong hairs ranged along the posterior margin. Legs concolorous with body.

Abdomen elongate ovate, with long hairs in the posterior angles of segments and a series of long hairs along the posterior margin of each segment; ground color whitish showing in broad, transverse sutural bands; each segment with a pale, reddish brown, transverse band, darker and with a subtransparent, curving space at each end; posterior margin of last segment smoothly rounded with a few rather long weak hairs.

Female larger, length 2. mm., width .78 mm.; head, length .3 mm., width .53 mm.; abdomen more elongate, last segment less broadly rounded, and with a narrow, transparent, posterior border thickly fringed with fine transparent hairs.

Menopon infrequens n. sp. (Plate xv, fig. 5.)

A single female taken from a Glaucous-winged Gull, *Larus glaucescens* (Bay of Monterey, California).

Description of female. Body, length 2 mm., width .81 mm.; brown with chestnut, transverse abdominal bands, narrow black lateral bands, and broadly linear, diagonal, black, ocular blotches.

Head, length .31 mm., width .62 mm., thus being just twice as wide as long; brown with darker fuscous clouds; narrow black occipital margin; black ocular blotches in the form of diagonal bars; some indefinite pale to uncolored spaces, as in the posterior angles, along the front, and a more definite circular space containing a long hair and a spine on each side of the forehead just outside of the origin of the labial palpi; on the front four short hairs near the middle, and on the sides in front of the ocular region two short hairs and one longer but weak hair; temporal angles with three long hairs, one one-half as long and some shorter hairs; occipital margin with four pustulated hairs; on ventral aspect occipital bands showing, enclosing an orbicular occipital signature, with a series of five pustulated hairs along the lateral margins.

Prothorax, with fourteen long, pustulated hairs extending in series from lateral angle to lateral angle along the posterior margin, which in its middle third is almost straight; ground color of segment largely clouded with fuscous to dark brown, especially in lateral angle region, which is very narrowly margined with black; the usual transverse line in front of middle with curving longitudinal lines at the ends especially distinct. Metathorax with lateral emargination and dark brown sutural lines separating mesothorax; posterior margin straight, with a series of not very long hairs, and two or three hairs and a spine in the posterior angles; a fuscous transverse band across posterior half of segment, with its lateral margins black. Sternal markings composed of a small trapezoid on prothorax with the posterior angles produced, and a broad blotch on metathorax; the anterior coxæ are produced forward and backward into broad lobe-like appendages, rounded in front and angulated behind. Legs concolorous with ground color of the body, with darker margins.

Abdomen, elongate ovate, with one long hair and several short ones rising on margin just in front of each uncolored posterior angle, and a series of hairs along posterior margins of segments; segments 1–8 with a broad, transverse, fuscous band darker at lateral extremities and black on extreme lateral margins; segment 9 uniformly colored, broadly rounded with narrow, uncolored, fringed, posterior margin.

Menopon loomisii n. sp. (Plate xv, fig. 6.)

Specimens taken from two specimens of the White-winged Scoter, *Oidemia deglandi* (Bay of Monterey, California). Named after Mr. Leverett M. Loomis, Curator of Birds, California Academy of Sciences.

Decription of female. Body, length 1.8 mm., width .84 mm.; pale golden brown to pale chestnut brown.

Head, length .3 mm., width .56 mm.; semilunar with evenly rounding front, shallow ocular emarginations, and rounded posterior angles; occipital margin concave; palpi projecting by the length of the last segment; the antennæ when outstretched projecting beyond the margin of head by the length of the last segment; a pair of very small hairs in middle of front, a longer one on side followed by a very short one, and then two or three longer ones in front of the emargination; the ocular fringe composed of few but rather strong hairs longer than usual; temporal margins with three very long hairs and two more on occipital margin of the produced temples; four additional hairs on the occipital margin; a small, black, ocular fleck, dark brown ocular blotch, the mandibles black-tipped, the other mouth-parts and the basal segments of the palpi brown.

Prothorax with produced lateral angles obtuse, bearing two spines and a long hair, which is the terminal one in a series of fourteen ranged along the rounded posterior margin of the segment; the transverse line with curving vertical lines at its extremities is distinct. Metathorax with divergent sides, not quite as wide as head, with flatly convex posterior margin bearing a series of long hairs; in each lateral angle several small spines and the terminal hair of the posterior series. Legs concolorous with body; with scattered, rather long hairs.

Abdomen ovate, with broad transverse bands across all segments separated by wide uncolored sutures; in the anterior angles of each transverse band a small curving comma-like chitinous band; the segments with fine hairs on lateral margins, and longer weak hairs in the posterior angles; dorsal surface with hairs.

Menopon titan Piaget. (Plate xv, fig. 2.)

Les Pediculines, 1880, p. 503, pl. xl, fig. 7.

Tetraopthalmus chilensis Grosse, Zeitschr. f. wiss. Zool., 1885, vol. xlii, p. 530.

Many specimens of this species, or of a variety, found on four of five specimens examined of California Brown Pelican, *Pelicanus californicus* (Bay of Monterey, California), and on the White Pelican, *Pelicanus erythrorhynchus* (Lawrence, Kansas). These large conspicuous parasites are found not alone among the feathers of the host but also abundantly clinging to the inner surface of the gular pouch, a circumstance which suggests that feathers may not constitute the exclusive food of the parasites.

Piaget has described two species of these giant *Menopons* of the Pelicans, viz.: *titan* found on *Pelecanus ono-*

crotalus (Zool. Garden of Rotterdam) and *consanguineum* (Les Pediculines, Supplement, 1885, p. 116, pl. xii, fig. 7) found on *P. erythrorhynchus* (dried skin in Museum of Leyden). Picaglia has described a third species *ragazzi* (Atti d. Soc. d. Nat. d. Modena, 1885, serie iii, vol. ii) found on *P. trachyrhynchus* (Callao), and has established the subgenus *Piagetia* for the group. The characters of the subgenus are as follows: "abdomen narrow and very elongate; male longer than female; length more than 5 mm." The remaining members of the genus *Menopon* present in contrast these characters: "abdomen oval-elongate, rounded oval, or almost round; male smaller than the female; length varying from 1 to 3 mm." The species chiefly used by Franz Grosse in his study of the anatomy of the Mallophaga was a member of this *Menopon titan* group, taken from a Pelican, undetermined, from Chile.

It certainly seems advisable to indicate the peculiar characters of the group by assigning to it a subgeneric name; but I can hardly recognize in Picaglia's description of *ragazzi* characters other than the dimensions which make it recognizably distinct from *titan*. My specimens from *Pel. erythrorhynchus* show the slight variations from *titan* indicated by Picaglia in his description of *ragazzi*, but the dimensions are quite as large as those of *titan* (Picaglia made *ragazzi* one-fourth shorter than *titan*)! My specimens from *Pel. californicus* closely correspond with Piaget's description of *titan*, except that the transverse abdominal blotches are not bifurcated at the extremities. I believe that the present knowledge of the group hardly justifies any separation of the known forms into distinct species, but that the presence of these variations may be recognized by letting *titan* stand as the representative form of the species (*consanguineum* is evidently a distinct species, the equality in size of both sexes removing any likelihood of confusing it with *titan)*, and by designating *ragazzi* and my specimens as varieties presenting the following diagnostic characters:

Var. *ragazzia* Picaglia, from *Pelecaus trachyrhynchus* (Callao); small, length of male 3.42 mm., of female 3.15 mm.; mesothoracic suture indistinct; metathorax a little wider than the head; general color paler than *titan*.

Var. *impar* Kellogg, from *Pelecanus erythrorhynchus* (Lawrence, Kansas); with the minor differential characters of *ragazzi*, but almost as large as *titan;* length of male 4.7 mm., of female 3.8 mm.

Var. *linearis* Kellogg (Plate xv, fig. 2), from *Pelecanus californicus;* about same size as *titan;* length of male 5.2 mm., of female 4.2 mm.; transverse abdominal blotches not bifurcated at extremities, and the longitudinal uncolored lines beyond spiracles very distinct in female, forming an interrupted, uncolored, longitudinal line for full length of abdomen, setting off lateral abdominal bands which are darker than the other abdominal markings.

Menopon tridens Nitzsch. (Plate xv, figs. 3 and 4.)

? Germar's Mag. Entomol., 1818, vol. iii.

Læmobothrium tridens Nitzsch. Zeitzschr. f. ges. Naturwiss. (ed. Giebel), 1866, vol. xxviii, p. 396.

Menopon scopulacorne Denny. Monograph. Anoplur. Brit., 1842, p. 221, pl. 18, fig. 9.

Menopon tridens Nitzsch. Burmeister, Handbuch. d. Ent., 1832, vol. ii, p. 440; Giebel, Insecta Epizoa, 1874, p. 296, pl. xvii, fig. 9; Piaget, Les Pediculines, 1880, p. 479, pl. xxxix, fig. 1.

I have taken several specimens of a *Menopon* from Coots, Grebes, and Loons and from a single Tern, which are referable to this species, or at least to the group of forms of which *tridens* is the described representative. The descriptions of *tridens* by Piaget and by Giebel differ positively in various particulars, noticeably in the charracters of the hairs. My specimens agree exactly with neither of these descriptions, and besides differ among themselves in size and shape of head to such a degree that I have arranged them in three groups to which I give, tentatively, varietal rank. These varieties are as follows:

Var. *pacificum* Kellogg, from the Pacific Loon, *Urinator pacificus* (Bay of Monterey, California), and from five specimens out of ten of the American Coot, *Fulica americana*, shot near Monterey, California, and on two specimens out of five of the same bird species from Lawrence, Kansas; measurements, female, length 1.65 mm., width .62 mm.; head, length .28 mm., width .5 mm.; smaller than the succeeding variety which it otherwise resembles.

Var. *insolens* Kellogg (plate xv, figs. 3 and 4), from an Eared Grebe, *Colymbus nigricollis californicus* (Bay of Monterey, California), and from a Forster's Tern, *Sterna forsteri* (Lawrence, Kansas); measurements, female, length 2. mm., width .72 mm.; head, length .31 mm., width .53 mm.; markings distinct and dark; lateral bands of abdomen nearly black.

Var. *par* Kellogg, from a Western Grebe, *Æchmophorus occidentalis* (Lawrence, Kansas); measurements, female, length 2. mm., width .78 mm., head, length .31 mm., width .56 mm.; decidedly paler colors.

As already mentioned none of these varieties agrees with Piaget's or with Giebel's description of the species. The notable differences lie in the dimensions, in the presence through all of the varieties of six hairs on the occipital margin (Giebel says four; Piaget says two); and similarly through all the varieties the clear brown color of the lateral abdominal bands instead of an uncolored condition as affirmed by Piaget. The specimens of Piaget were taken from *Gallinula chloropus;* and his variety *major* based simply and certainly insufficiently on a difference in size amounting to but one-tenth of a millimeter in total length in the female and half that in the male, was taken on *Fulica atra*. Nitzsch found the species on *Fulica atra*, *Gallinula chloropus*, *Crex porzana*, *Podiceps auritus*, *Podiceps cristatus*; Denny found his *scopulacorne* on *Rallus aquaticus*, *Podiceps minor* and *Gallinula chloropus*. The species is easily recognized by the peculiar trilobed process, function unknown, on the under side of the hind-head (see fig. 4, pl. xv).

EXPLANATION OF PLATES.

PLATE II.—Fig. 1, Alimentary canal and salivary glands of *Menopon mesoleucum* (after Nitzsch). Fig. 2, Alimentary canal of *Docophorus fusicollis* (after Nitzsch). Fig. 3, Nervous system of *Lipeurus baculus*(?) (after Nitzsch). Fig. 4, Female genitalia of *Menopon mesoleucum* (after Nitzsch). Fig. 5, Male genitalia of *Menopon pallidum* (after Nitzsch). Fig. 6, Respiratory system of *Menopon titan* (original). Fig. 7, Head, under side, of *Læmobothrium* sp. (after Grosse). Fig. 8, Labium of *Tetraopthalmus chilensis* [=*Menopon titan*(?)] (after Grosse). Fig. 9, Labium of *Nirmus* sp. (after Grosse). Fig. 10, Antenna of *Tetraopthalmus chilensis* [=*Menopon titan*] (after Grosse). Fig. 11, Antenna of ♀ *Lipeurus*. Fig. 12, Antenna of ♂ *Lipeurus*. Fig. 13, Leg of ♂ *Tetraopthalmus chilensis* [=*Menopon titan*].

PLATE III.—Fig. 1, *Docophorus calvus* Kell., ♀. Fig. 2, *D. fuliginosus* Kell., ♂. Fig. 3, *D. graviceps* Kell., ♂. Fig. 4, *D. acutipectus* Kell., ♀. Fig. 5, *D. quadraticeps* Kell., ♀. Fig. 6, *D. montereyi* Kell., ♂. Fig. 7, *D. occidentalis* Kell., ♀. Fig. 8, *D. kansensis* Kell., ♀. Fig. 9, *D. atricolor* Kell., ♂.

PLATE IV.—Fig. 1, *Docophorus icterodes* N., ♀. Fig. 2, *D. pertusus* N., ♀ Fig. 3, *D. pertusus* N., juv. Fig. 4, *D. lari* Denny, ♀. Fig. 5, *D. insolitus* Kell., ♀. Fig. 6, *D. melanocephalus* Burm., ♀.

PLATE V.—Fig. 1, *Nirmus præstans* Kell., ♂. Fig. 2, *N. præstans* Kell., ventral aspect abdomen of ♂. Fig. 3, *N. hebes* Kell., ♀. Fig. 4, *N. farallonii* Kell., ♀. Fig. 5, *N. orarius* Kell., ♀(?). Fig. 6, *N. giganticola* Kell., ♂. Fig. 7, *N. bœphilus* Kell., ♀.

PLATE VI.—Fig. 1, *Nirmus punctatus* N., ♀. Fig. 2, *N. punctatus* N., juv. Fig. 3, *N. felix* Giebel, ♂. Fig. 4, *N. felix* Giebel, ventral aspect abdomen of ♂. Fig. 5, *N. signatus* P., ♂. Fig. 6, *N. pileus* N., ♀. Fig. 7, *N. lineolatus* N., ♂. Fig. 8, *N. lineolatus* N., ventral aspect abdomen of ♂. Fig. 9, *N. lineolatus* N., juv.

PLATE VII.—Fig. 1, *Lipeurus densus* Kell., ♀. Fig. 2, *L. densus* Kell., ventral aspect head and thorax of ♀. Fig. 3, *L. varius* Kell., ♀. Fig. 4, *L. varius* Kell., juv. Fig. 5, *L. celer* Kell., ♂. Fig. 6, *L. celer* Kell., ♀. Fig. 7, *L. longipilus* Kell., ♂.

PLATE VIII.—Fig. 1, *Lipeurus picturatus* Kell., ♀. Fig. 2, *L. picturatus* Kell., ♀ juv. Fig. 3, *L. diversus* Kell., ♂. Fig. 4, *L. diversus* Kell., ♀. Fig. 5, *L. limitatus* Kell., ♀. Fig. 6, *L. limitatus* Kell., outline of metathorax to show arrangement and character of hairs. Fig. 7, *L. constrictus* Kell., ♀ juv. Fig. 8, *L. constrictus* Kell., ♂.

PLATE IX.—Fig. 1, *Lipeurus ferox* Giebel, ♀. Fig. 2, *L. ferox* Giebel, ♂. Fig. 3, *L. forficulatus* Nitzsch, ♀. Fig. 4, *L. forficulatus* Nitzsch, ♂. Fig. 5, *L. forficulatus* Nitzsch, juv. Fig. 6, *L. forficulatus* Nitzsch, very young.

PLATE X.—Fig. 1, *Lipeurus temporalis* Nitzsch, ♂. Fig. 2, *L. testaceous* Tschb., juv. Fig. 3, *L. toxoceros* Nitzsch, juv. Fig. 4, *L. testaceous* Tschb., ♀. Fig. 5, *L. toxoceros* Nitzsch, ♂. Fig. 6, *L. squalidus* Nitzsch, ♀. Fig. 7, *L. squalidus* Nitzsch, posterior margin of metathorax showing arrangement and character of hairs.

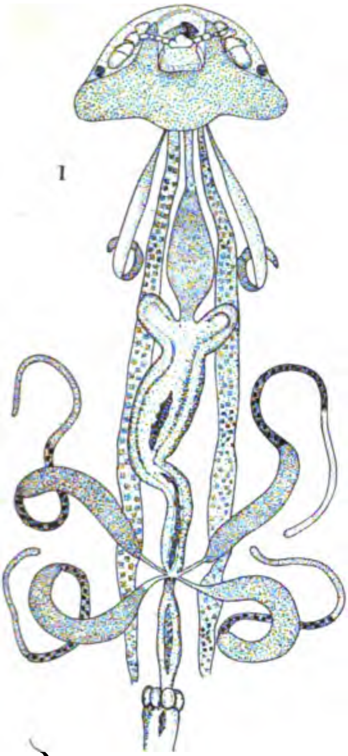
PLATE XI.—Fig. 1, *Oncophorus advena* Kell., ♀. Fig. 2, *O. advena* Kell., head of ♂. Fig. 3, *Eurymetopus taurus* Nitzsch, ♀. Fig. 4, *E. taurus* Nitzsch, head of ♂. Fig. 5, *E. taurus* Nitzsch, ♀ juv. Fig. 6, *E. taurus* Nitzsch, ♂ juv. Fig. 7, *Giebelia mirabilis* Kell., ♂. Fig. 8, *G. mirabilis* Kell., outline of head of ♀.

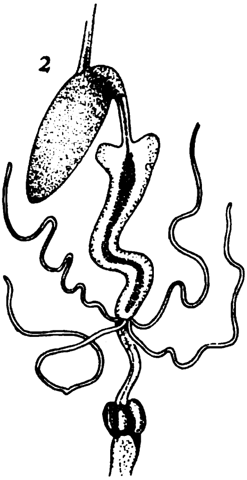
PLATE XII.—Fig. 1, *Colpocephalum unciferum* Kell., ♂. Fig. 2, *C. unciferum* Kell., outline and last segments of abdomen of ♀. Fig. 3, *C. unciferum* Kell., juv. Fig. 4, *C. uniforme* Kell., ♀. Fig. 5, *C. pingue* Kell., ♂. Fig. 6, *C. timidum* Kell., ♀. Fig. 7, *C. funebre* Kell., ♀. Fig. 8, *C. laticeps* Kell., ♂.

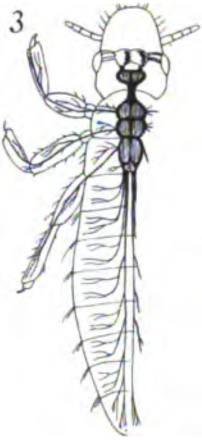
PLATE XIII.—Fig. 1, *Ancistrona gigas* Piaget, ♂. Fig. 2, *Ancistrona gigas* Piaget, juv. Fig. 3, *Trinoton lituratum* Nitzsch, ♀. Fig. 4, *Trinoton luridum* Nitzsch, ♀.

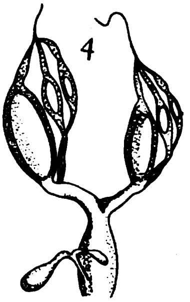
PLATE XIV.—Fig. 1, *Læmobothrium similis* Kell., ♂. Fig. 2, *L. similis* Kell., ventral aspect of head of ♀. Fig. 3, *L. atrum* Nitzsch, ♀ (?). Fig. 4, *Menopon navigans* Kell., ♂. Fig. 5, *M. navigans* Kell., juv. Fig. 6, *M. indistinctum* Kell., ♀. Fig. 7, *M. indistinctum* Kell., ventral aspect of thorax of ♀.

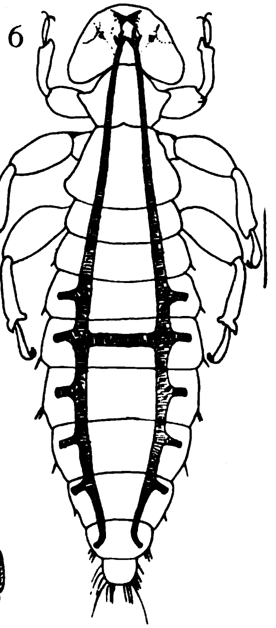
PLATE XV.—Fig. 1, *Menopon numerosum* Kell., ♀. Fig. 2, *M. titan* var. *linearis* Kell., ♂. Fig. 3, *M. tridens* var. *insolens* Kell., ♀. Fig. 4, *M. tridens* var. *insolens* Kell., ventral aspect of head of ♀. Fig. 5, *M. infrequens* Kell., ♀. Fig. 6, *M. loomisii* Kell., ♀.

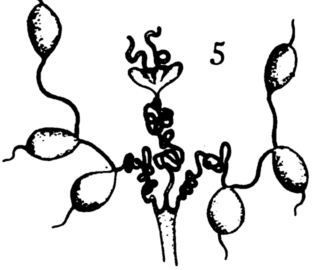

1

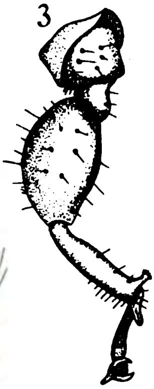

2

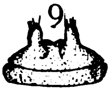

3

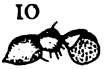

4

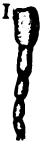

6

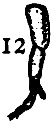

5

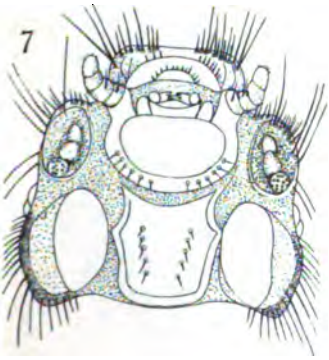

3

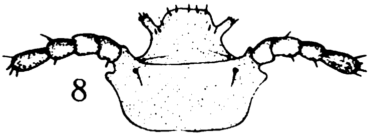

9


10


11

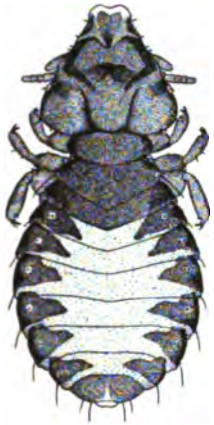

12


7

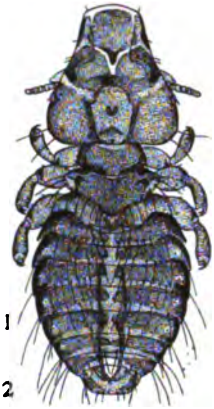

8

EDNA HYATT DEL. AND V. L. KELLOGG, DEL.

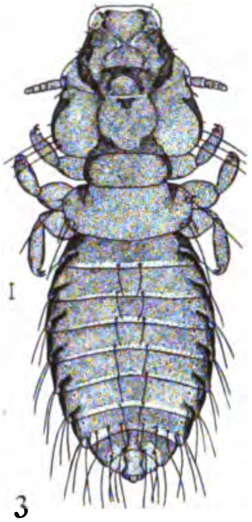
LITH. BRITTON & REY S.F.



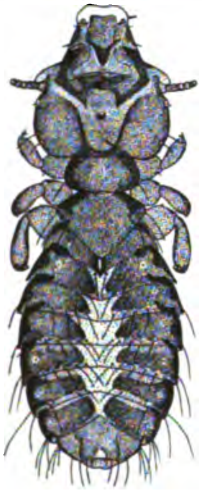
1



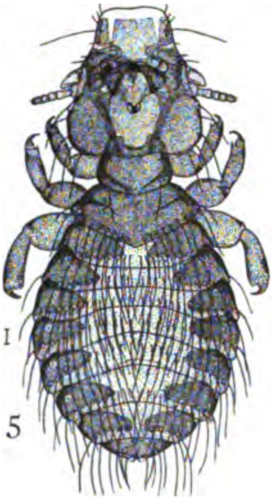
2



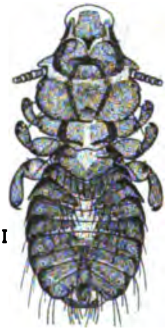
3



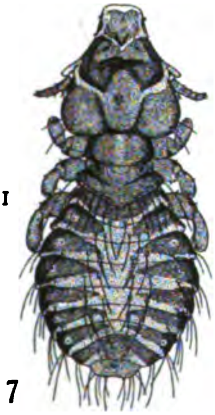
4



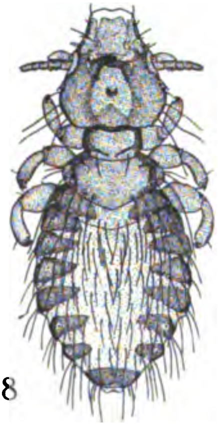
5



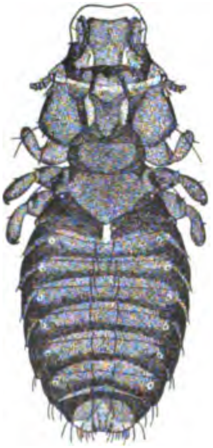
6



7



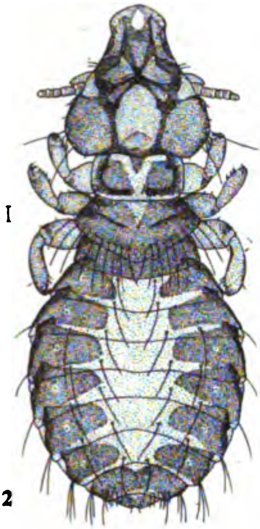
8

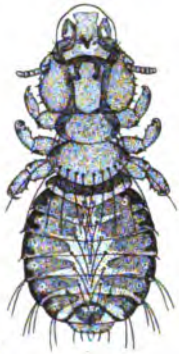


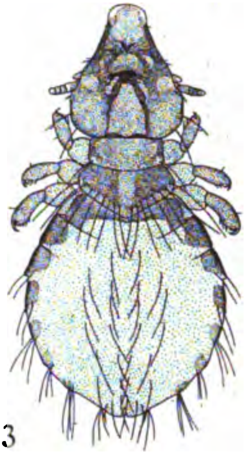
9

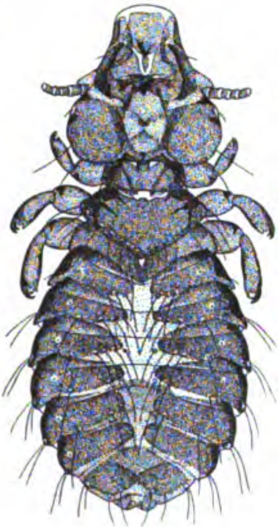
EDNA HYATT, DEL.

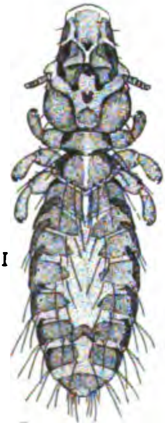
LITH. BRITTON & REY, S.F.

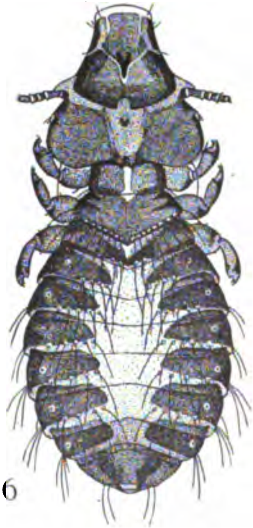

2


1

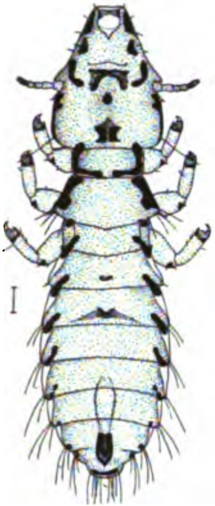

3


4

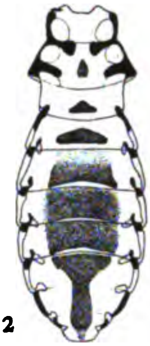

5


6

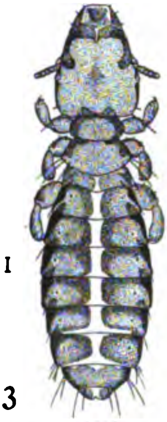
EDNA HYATT, DEL. LITH. BRITTON & REY. S.F.



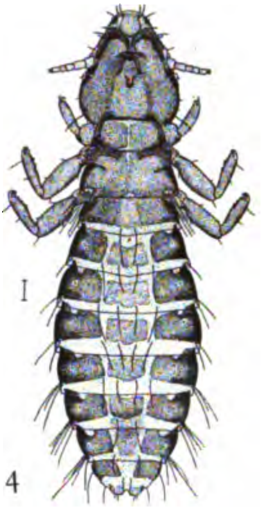
1



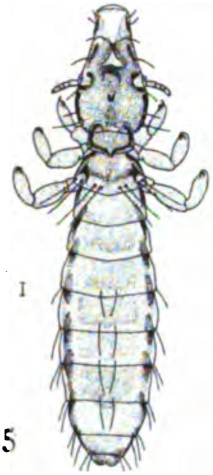
2



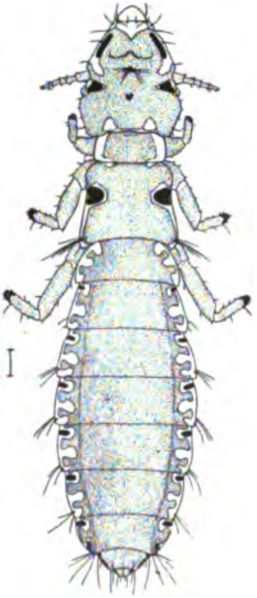
3



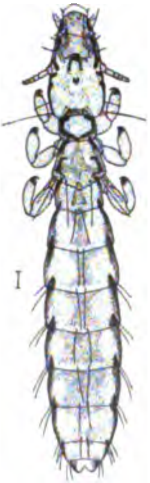
4



5



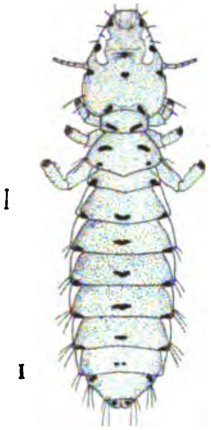
6

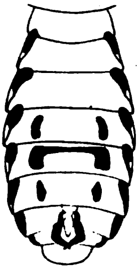


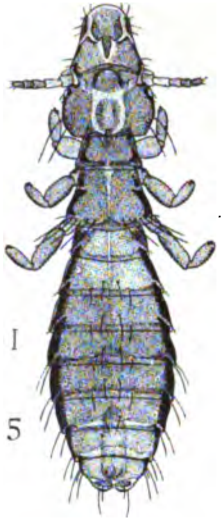
7

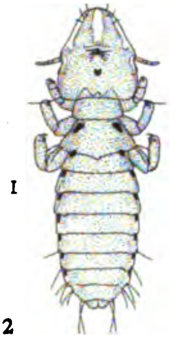
EDNA HYATT, DEL.

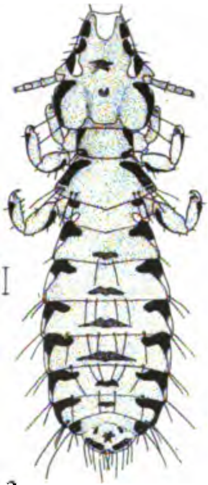
LITH. BRITTON & REY S.F.

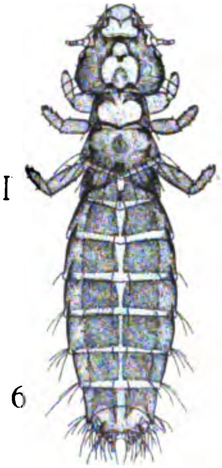

1

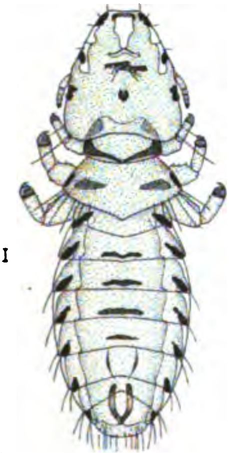

4

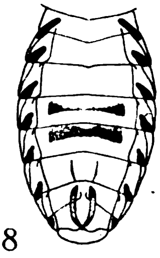

5

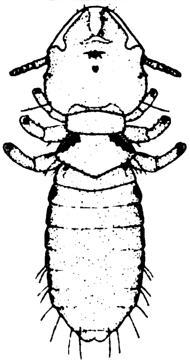

2


3

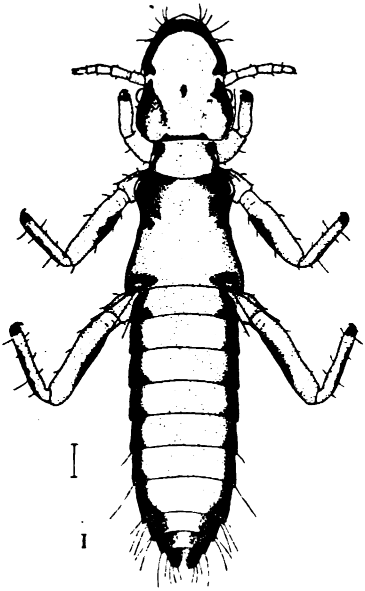

6

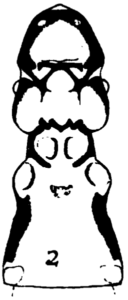

7

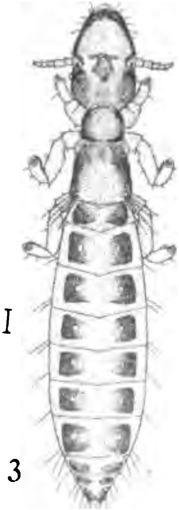

8

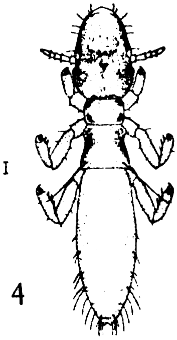

9

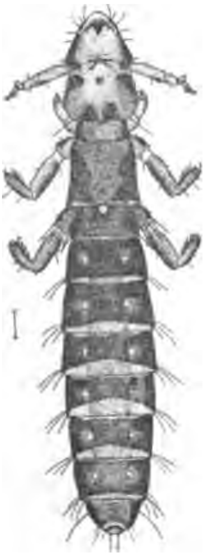
EDNA HYATT, DEL. LITH. BRITTON & REY, S.F.

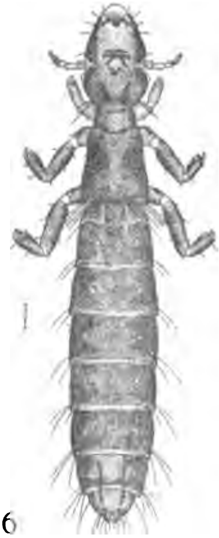

1

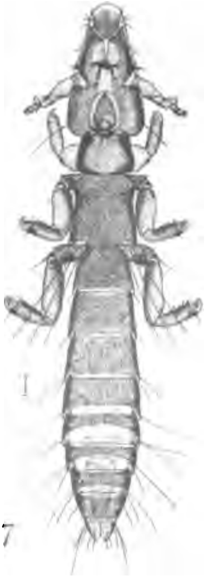


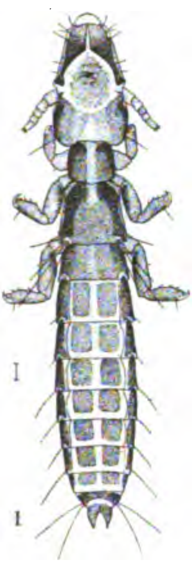

3

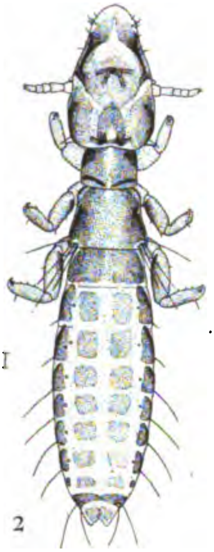

4

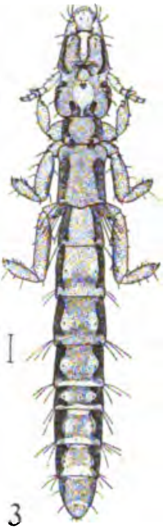

5

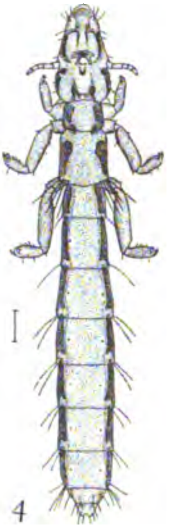

6

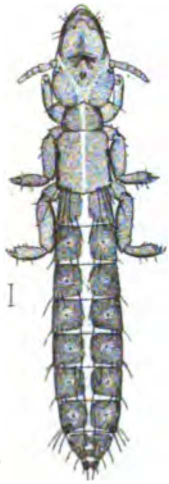

7

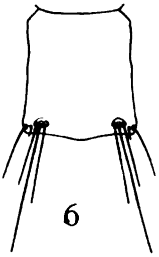

1

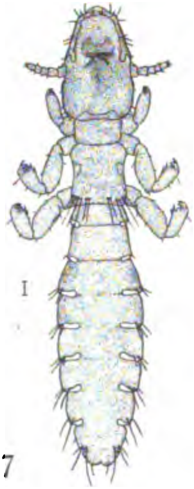

2

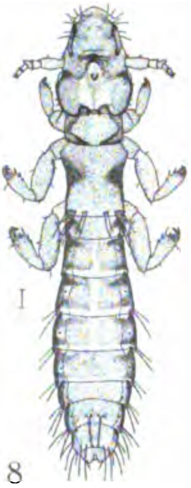

3


4


5

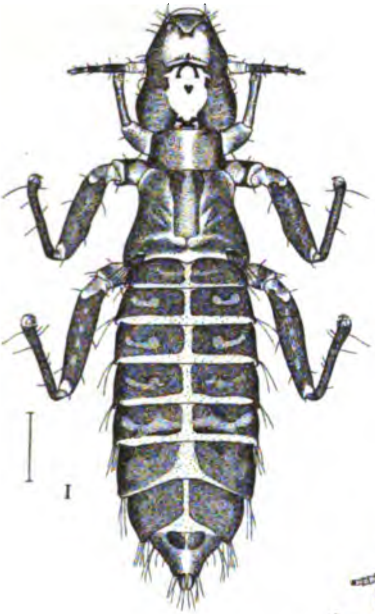

6

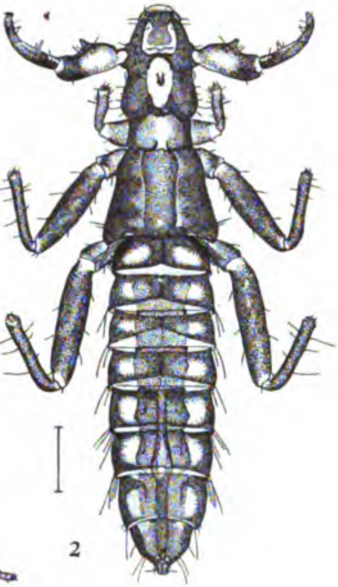

7

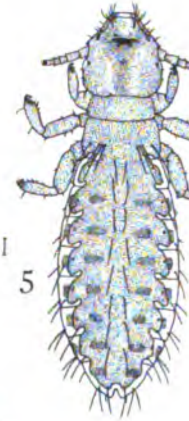

8

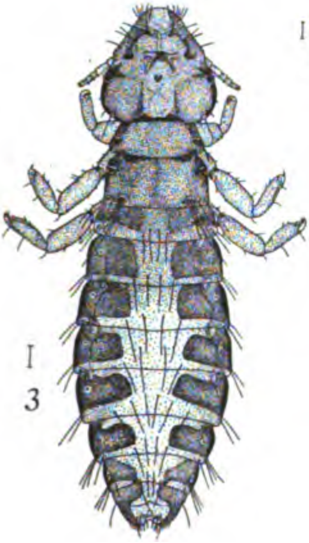
EDNA HYATT, DEL.

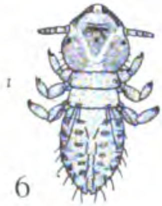
LITH. BRITTON & REY, S.F.

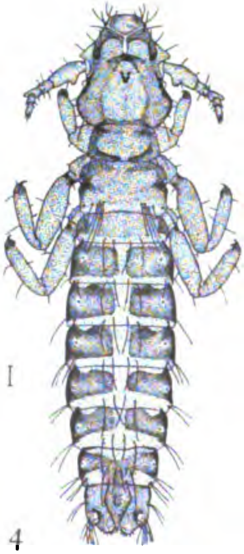






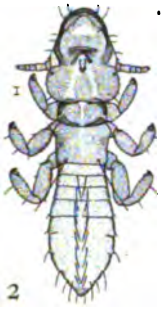


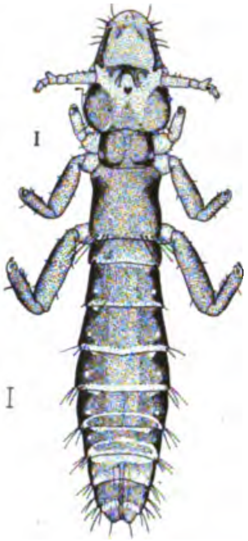


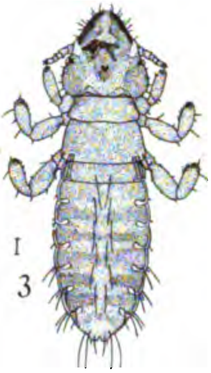


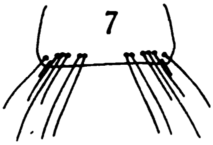
EDNA HYATT, DEL.

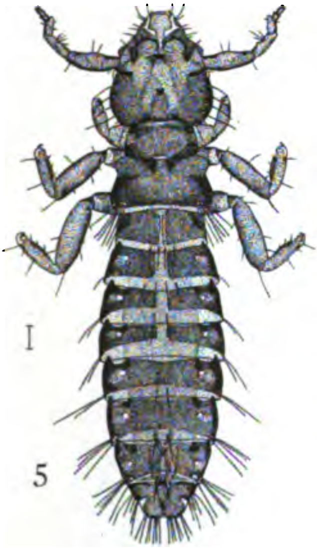
LITH. BRITTON & REY S.F.

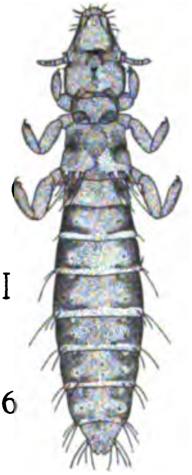

2

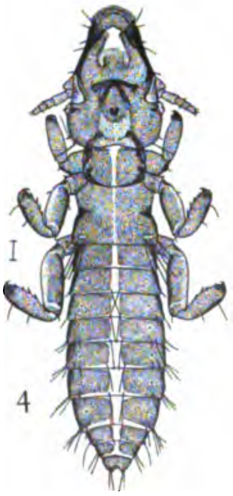



3

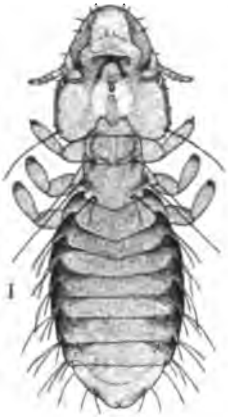

7

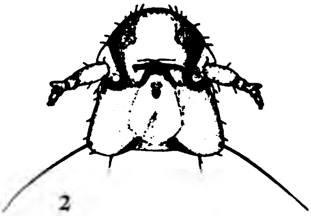

5


6

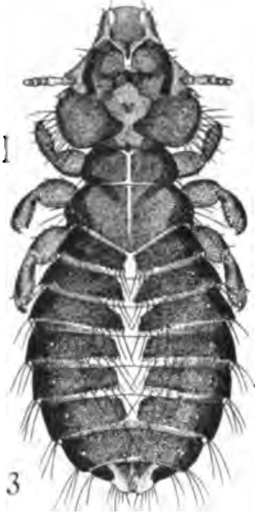

4

EDNA HYATT, DEL. LITH. BRITTON & REY S.F.

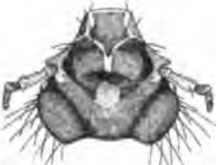




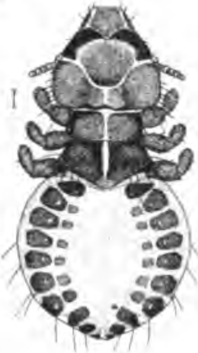
2



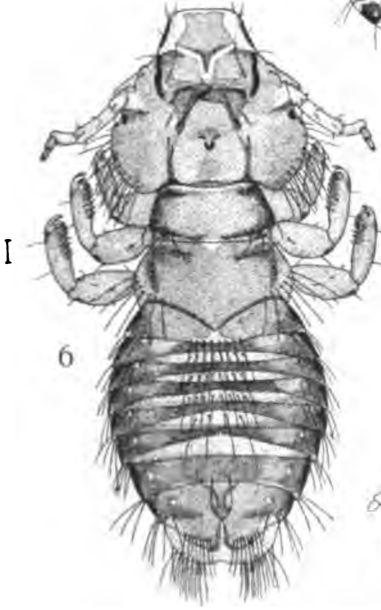
3



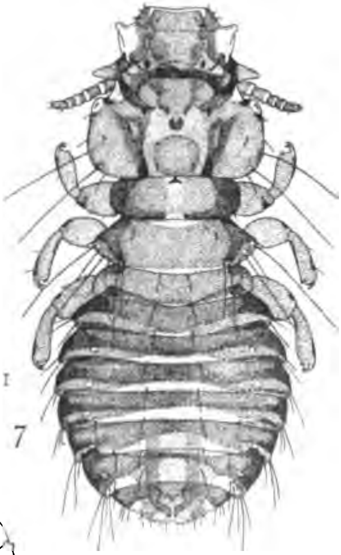
4



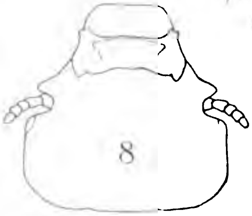
5



6



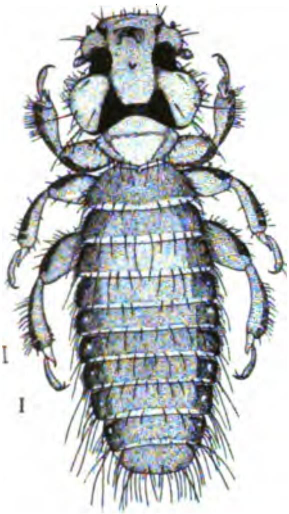
7

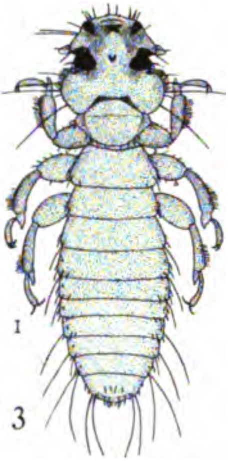


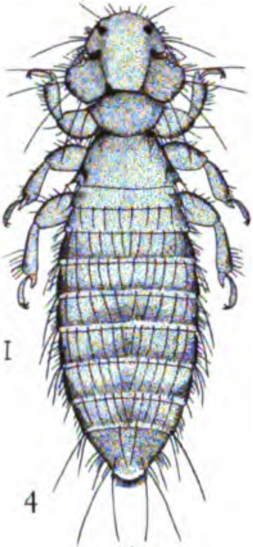
8

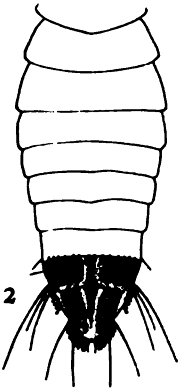
Edna Hyatt, Del.

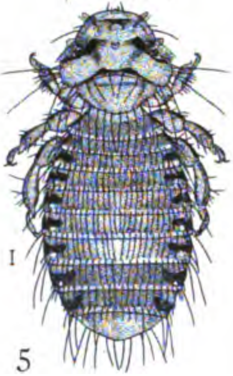
Lith. Britton & Rey, S.F.

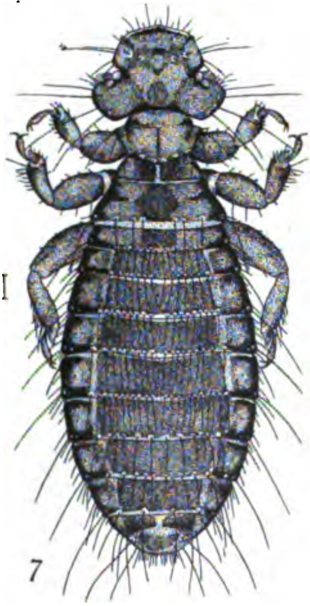


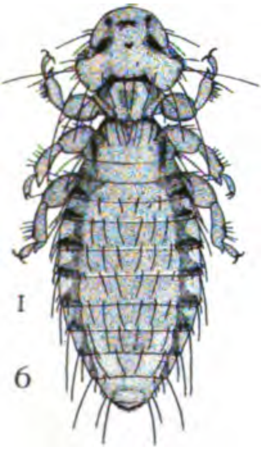

3

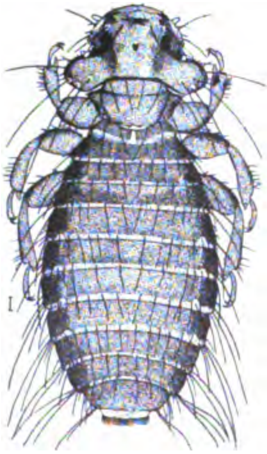

4


2

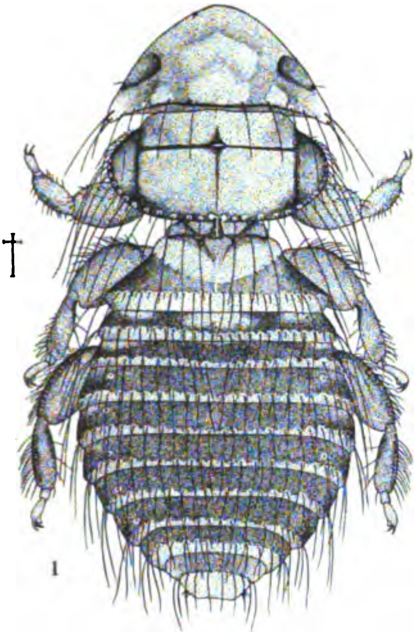

5


7

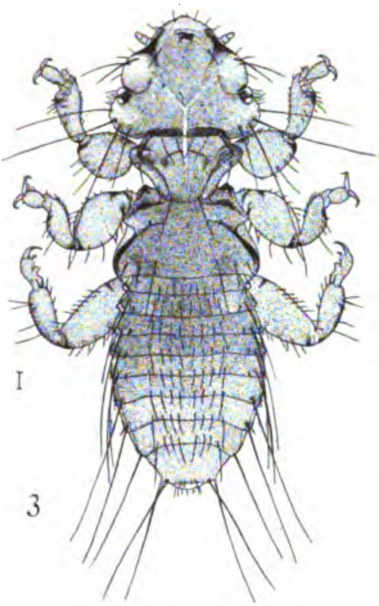

6


8

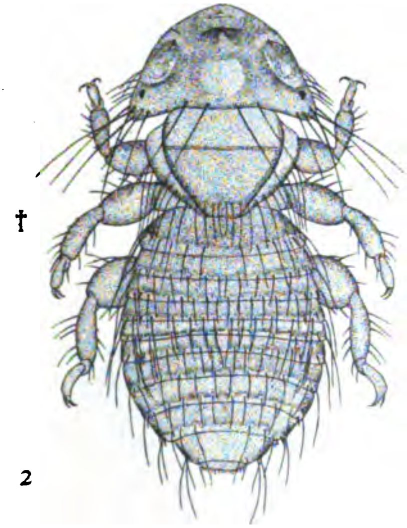
EDNA BYATT, DEL. LITH. BRITTON & REY S.F.



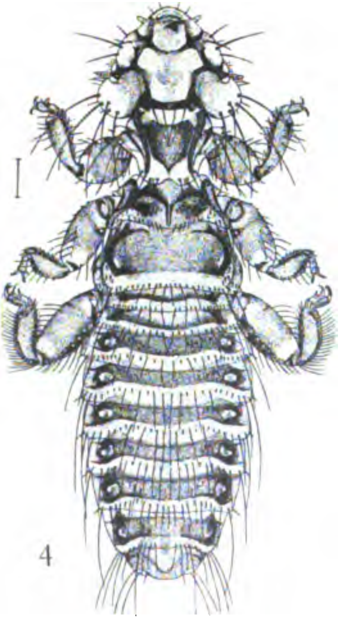
1



3



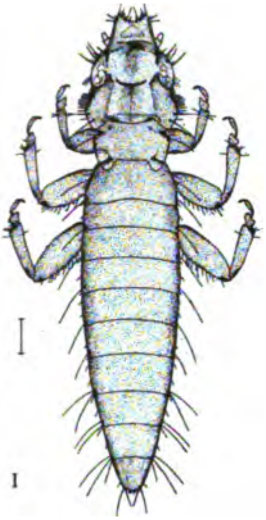
2



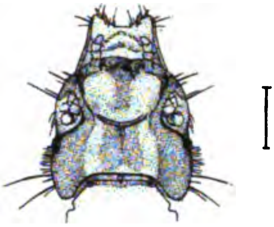
4

Edna Hyatt, Del.

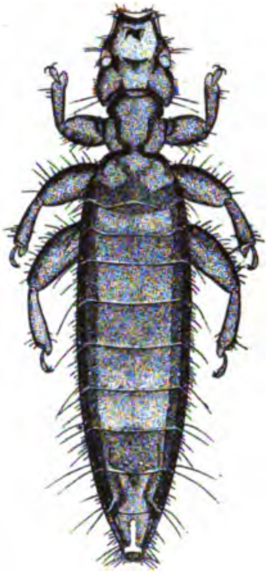
LITH. BRITTON & REY, S.F.



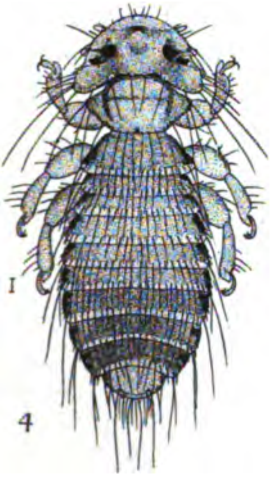
1



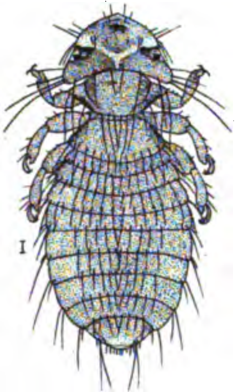
2



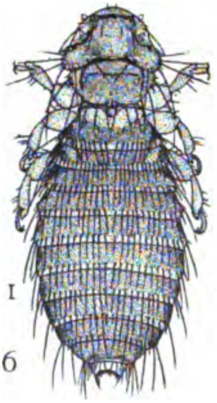
3



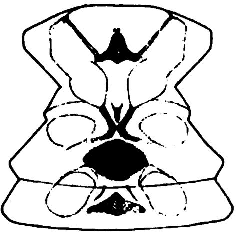
4



5



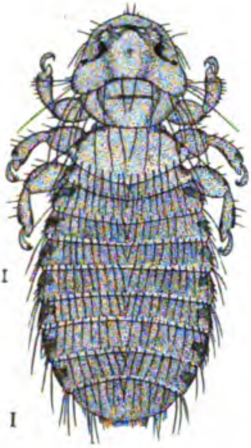
6

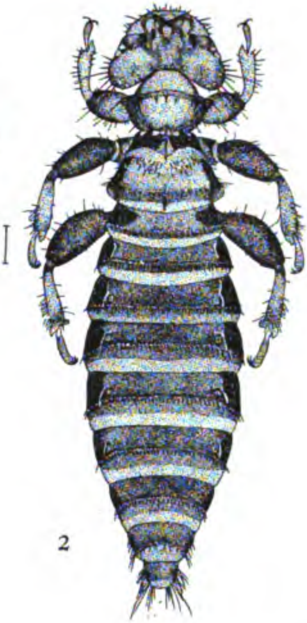


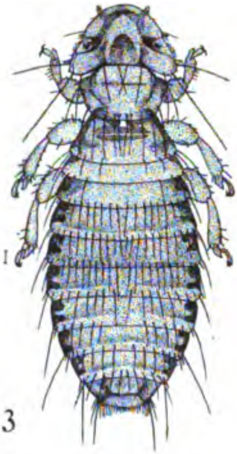
7

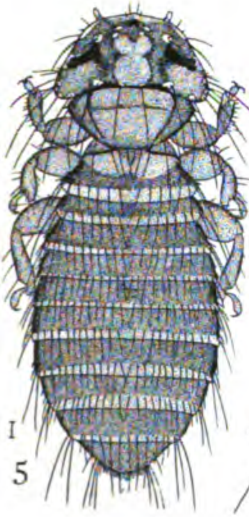
Edna Hyatt, Del.

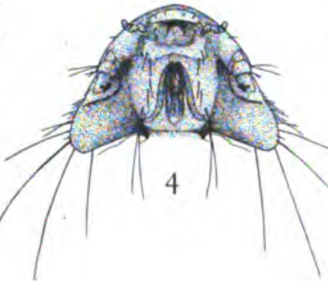
Lith. Britton & Rey, S.F.

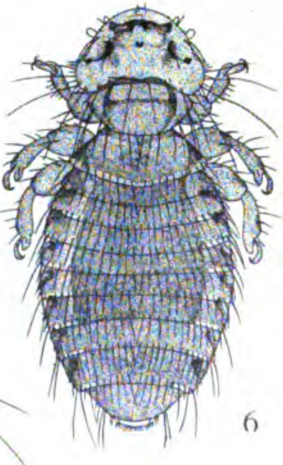

1


2


3


5


4


6

EDNA HYATT DEL.

LITH. BRITTON & REY, S.F.

LELAND STANFORD JUNIOR UNIVERSITY PUBLICATIONS

CONTRIBUTIONS TO BIOLOGY

FROM

THE HOPKINS SEASIDE LABORATORY

V

NOTES ON FISHES,

Little Known or New to Science.

BY

DAVID STARR JORDAN,

President of the Leland Stanford Jr. University.

LELAND STANFORD JR. UNIVERSITY,
PALO ALTO, CALIFORNIA,
1896.

LELAND STANFORD JUNIOR UNIVERSITY PUBLICATIONS

CONTRIBUTIONS TO BIOLOGY

FROM

THE HOPKINS SEASIDE LABORATORY

V

NOTES ON FISHES,

Little Known or New to Science.

BY

DAVID STARR JORDAN,

President of the Leland Stanford Jr. University.

(Reprint from the Proceedings of the California Academy of Science , Series 2, Vol. VI.)

LELAND STANFORD JR. UNIVERSITY,
PALO ALTO, CALIFORNIA,
1896.

PREFATORY NOTE.

This memoir is the fifth of a series designed to illustrate the investigations and explorations of the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. The series is issued under the patronage of Timothy Hopkins, Esq., of Menlo Park, California. The present paper is published with the co-operation of the California Academy of Sciences, appearing simultaneously in its present form and as part of the Proceedings of the Academy.

CHARLES H. GILBERT,
OLIVER P. JENKINS,
Editors.

Date of publication, June 19, 1896.

NOTES ON FISHES, LITTLE KNOWN OR NEW TO SCIENCE.*

BY DAVID STARR JORDAN.

(With Plates xx-xliii.)

The present paper is made up of descriptions of new species of fishes, with notes on little known forms. The material examined, unless otherwise stated, is in the Museum of the Leland Stanford Jr. University, and most of the species referred to belong to the fauna of the Eastern Pacific.

In this paper the following new genera and species are mentioned for the first time:

Zaprora Jordan.
Zaprora silenus Jordan.
Salmo gairdneri crescentis Jordan & Beardslee.
Salmo gairdneri bairdsleei Jordan & Seale.
Umbrina sinaloæ Scofield.
Emmydrichthys vulcanus Jordan & Rutter.
Cottus annæ Jordan & Starks.
Cottus shasta Jordan & Starks.
Tarandichthys Jordan & Evermann.
Oligocottus borealis Jordan & Snyder.
Ulca Jordan & Evermann.
Eleotris abacurus Jordan & Gilbert.
Clevelandia rosæ Jordan & Evermann.
Brysselœres Jordan & Evermann.
Arbaciosa Jordan & Evermann.
Rimicola Jordan & Evermann.
Starksia Jordan & Evermann.
Exerpes Jordan & Evermann.
Chasmodes jenkinsi Jordan & Evermann.
Sebastodes eigenmanni Cramer.
Sebastodes gilberti Cramer.

The accompanying plates are drawn by Miss Anna Louise Brown.

---

*Contributions to Biology from the Hopkins Seaside Laboratory. No. 5.

Zaprora silenus Jordan.

Through the courtesy of Mr. Ashdown H. Green, President of the Natural History Society of Victoria, in British Columbia, and of Mr. John Fannin, Curator of the Provincial Museum of British Columbia, at Victoria, I have been allowed to examine the large fish to which I have given the name of *Zaprora silenus*. This specimen, twenty-nine inches in length, was taken in the harbor of Nanaimo, on Vancouver Island. It represents a new genus, allied to *Icosteus*, *Icichthys*, *Schedophilus*, *Acrotus* and *Centrolophus*, but in its combination of characters it is so different from all of these that I have been obliged to give it separate family rank. The definition of the family *Zaproridæ* may for the present be that of the single known genus, *Zaprora*.

Family ZAPRORIDÆ.

Zaprora Jordan, n. g.

Body robust, moderately compressed, the back not elevated, the belly not carinate. Body covered with small adherent cycloid scales, which cover the membranes of all the fins except the distal third, as also the gill membranes, lower jaw, cheeks, opercles and nuchal region. No lateral line; no spinules. Head short, the nape not elevated, the forehead broad and abruptly convex in profile; eye moderate, placed high; preopercle, parietal region, and region about eye with very large open mucous pores. No spines on head; edges of membrane bones of head covered with thick scaly skin. Mouth moderate, terminal, oblique, its cleft mainly anterior; upper jaw protractile, but not movable; maxillary rather narrow, simple; lower jaw very heavy, its thick tip projecting beyond upper jaw. Teeth alike in both jaws, rather strong, blunt, even, close-set, forming a uniform cutting edge; no teeth on vomer, palatines or tongue, the tongue very thick. Lower pharyngeals narrow, with bluntish teeth, those on the edge larger; upper pharyngeals rather large, with small, blunt velvety teeth; no distinct tooth-like processes in the œsophagus; pseudobranchiæ present; gill-rakers very slender and flexible, rather short; gills four, a large slit behind the fourth; gill membranes separate, free from the isthmus; opercle adnate to shoulder girdle above its angle; coracoids not largely developed. Pectoral fin long, rounded, attached a little nearer ventral than dorsal outline; ventrals wholly wanting. Dorsal fin beginning above gill opening, composed entirely of simple inarticulate rays or spines, these moderately flexible, attached to the membrane to their tips, and all except the first and last of about equal length. Caudal peduncle short and stout, not contracted, the large caudal subtruncate or rounded at tip, and without procurrent rays; vent nearly median. Anal much shorter than dorsal, somewhat higher, and composed of soft rays, subequal in length. Skeleton rather limp and flexible, but much less so than in *Icosteus*.

Type *Zaprora silenus*, n. sp.

This genus bears some resemblance to *Icichthys*, but differs in the stout caudal peduncle, absence of ventrals and lateral line, and in the form and structure of the head. Among the genera known to me it seems to come nearest to *Icichthys*, and it might be placed among the *Icosteidæ*, were it not for the presence of pharyngeal teeth. I therefore place it provisionally in a distinct family, *Zaproridæ*, having at present the characters of the single known genus.

1. **Zaprora silenus** Jordan, n. sp. Plate xx.

Head $5\frac{3}{8}$ in length to base of caudal; depth $4\frac{1}{8}$. D

LVI; A. 27; P. 20 to 22; C. 22; scales about 200–85. Greatest thickness of body about $\frac{2}{5}$ its depth; length of caudal peduncle $1\frac{2}{5}$ in its least depth, which is $1\frac{9}{10}$ in head. Eye $5\frac{1}{3}$ in head; snout $5\frac{1}{3}$; interorbital space 3; maxillary $2\frac{3}{4}$, ending under front of pupil; mandible $2\frac{1}{2}$, its depth $4\frac{2}{3}$; teeth about $\frac{45}{50}$ on each side; lips, snout, and bones about eye naked; rest of head covered with small scales. Lower jaw with a thick lip slightly fringed on its edge, and with a mesial frenum; the rounded tip entering the profile when the mouth is closed. Three large pores on each ramus of mandible; behind these three others in a line on horizontal limb of preopercle; three on vertical limb; two close together in front of eye; one near the nostrils, so similar to them that there seems to be three nasal openings; seven on suborbitals; four in two rows behind eye; one above eye, and before upper edge of preopercle; a horizontal row of five along temporal region, the last and largest of all in opercular flap above gill opening; one at vertex; one between vertex and eye and two on each side of nape. Gill-rakers 8+20, the longest half eye. No trace of lateral line. Scales small, resembling those of a salmon, covering the membranes of all the fins on the basal two-thirds. Pectoral as long as head, its base $2\frac{1}{3}$ in head; longest dorsal spine $1\frac{5}{6}$; caudal $1\frac{1}{10}$; longest anal ray $1\frac{2}{5}$. Color in spirits uniform dusky, without markings on the body, the belly pale, and the side of the head irregularly blotched with lemon yellow, apparently bright in life, and brightest about the pores of the head.

Length of type (in the Provincial Museum at Victoria, B. C.), 29 inches.

From Nanaimo, Vancouver Island. Collector, H. T. Stainton.

The type, in alcohol, has been partly skinned and stuffed, and its form has been somewhat distorted. The form it now has is shown in the plate. In life it may have been more symmetrical, the back higher and the body deeper.

The type specimen was sent to the Provincial Museum at Victoria by Mr. H. T. Stainton of Nanaimo, who gives the following account of it in a letter to Mr. Ashdown H. Green, under date of Nanaimo, January 25, 1896:

"In reply to your favor of the 21st instant, which I have delayed answering in order to get the information you desire regarding the fish I sent to the museum. Mr. G. Marsh, a fish dealer, who gave me the fish, says it was caught on the 21st October, 1895, in the Straits of Georgia, a short distance north of Entrance Island Lighthouse [about three miles from Nanaimo—A. H. G.], by a fisherman named W. Crocker (who was fishing for codfish at the time), with a hand-line and hook baited with a piece of dogfish, in a depth of 150 feet of water. The inside, which was taken out by Mr. Marsh, was the same as that of the codfish (*Sebastodes*), and contained what appeared to be a jelly fish. When Mr. Marsh got the fish from the fisherman, it might be said to be still alive, and at that time the holes in its head were more distinct and the coloring around them of a deeper and richer lemon color than when it was packed for shipment to the museum."

Family NEMICHTHYIDÆ.

2. **Nemichthys avocetta** Jordan & Gilbert. Plate xxi.

Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 409. Port Gamble Wash.

In the same collection of the Provincial Museum at Victoria is a fine specimen of *Nemichthys avocetta*, the second specimen known. This was taken on the beach at Beacon Hill, near Victoria, by Mr. Norgate, in 1894, and sent to me for examination by Mr. Fannin. This agrees with the description of the original type, the slight differences separating that from *Nemichthys scolopaceus* of the Atlantic being constant. A generic character of *Nemichthys* not heretofore noticed is the division of the dorsal rays into two sorts, near the middle of the body, the anterior series being much longer than the others, and all being undivided or spine-like. This character is shown in the accompanying plates, taken from the Nanaimo specimen. This character does not exist in the related genus *Avocettina*.

3. **Avocettina gillii** (Bean). Plate xxi.

Labichthys gillii Bean, Proc. U. S. Nat. Mus., 1890, 45. Prince of Wales Island, Alaska.

For purposes of comparison, I present a figure of *Avocettina gillii*, from a specimen (No. 679, L. S. Jr. Univ.) taken by the Albatross at Station 2860. The genus *Avocettina* differs from *Labichthys* and *Nemichthys* in the backward position of the vent, and there is no division in the dorsal rays like that seen in *Nemichthys*.

THE TROUT OF LAKE CRESCENT, WASHINGTON.

Some months since Rear Admiral L. A. Beardslee, U. S. N., called my attention to the splendid trout found in Lake Crescent, a mountain lake in the Olympic Range, above Port Angeles, Washington. These trout, according to his view, were of two species, one or both of them new to science. These are locally known as the "Blueback" and the "Speckled" trout.

Recently, through the kindness of Mr. M. J. Carrigan of Port Angeles, and Mr. George E. Mitchell of Fairholme, one specimen of the speckled trout and two of the blue-back have been sent to me for examination. I find myself forced to agree with Admiral Beardslee in the opinion that each of these forms is distinct from any previously recorded or named. The two are allied to each other, rather than to any other form, and the nearest affinities of both seem to be with the steelhead trout *(Salmo gairdneri)* rather than any other. But placing the two as subspecies of *Salmo gairdneri* is simply a provisional arrangement, and there is just as good warrant for regarding each as a distinct species.

From all forms of *Salmo gairdneri* both the new forms differ in the large size of the head as well as in coloration and in the form of the snout and opercles. The size of scales, the form of the gill-rakers, the form of the opercle, the form of the pyloric cœca, the outline of the caudal, and the coloration, are different in the two forms.

4. **Salmo gairdneri crescentis** Jordan & Beardslee, n. subsp. SPECKLED TROUT OF LAKE CRESCENT. Plate xxii.

Head 3⅘ in length to base of caudal; depth 5; exposed portion of eye 6 in head, 1⅔ in snout; scales 32–151–34, 151 cross-series, 83 in front of dorsal; dorsal with 10 branched rays, anal with 11; branchiostegals 10; gill-rakers 6+11, counting rudiments, these very short and thick, the longest but $\frac{3}{16}$ inches in length, 18½ in maxillary; mouth large, maxillary extending much beyond eye, 1⅔ in head, with about 20 teeth; tongue with the usual teeth; teeth on vomer in zigzag series; hyoid region of tongue without teeth. Snout 3½ in head; preorbital very narrow, not so wide as maxillary adjacent to it; the posterior suborbitals longer than eye, 5⅓ in head; opercle and subopercle very narrow, scarcely as wide as eye, the free part of opercle 6⅓ in head; interorbital width 4¼ in head. Origin of dorsal in middle of length of body, its margin straight, anterior 2½ times posterior, and slightly longer than base, $2\frac{1}{3}$ in head. Last ray of dorsal pointed. Origin of anal midway between origin of dorsal and base of caudal, margin irregular, anterior rays three times length of posterior, and equal to base of fin, $2\frac{2}{5}$ in head. Adipose fin high and slender, situated immediately behind anal. Pectoral $1\frac{4}{5}$ in head. Ventrals under middle of dorsal, $2\frac{3}{5}$ in head. Caudal broad, slightly emarginate, nearly truncate when spread, its corners not rounded, its longest rays $1\frac{1}{2}$ in head. Least depth of caudal peduncle $3\frac{3}{5}$ in head. Pyloric cœca about 51, the longest about $1\frac{5}{6}$ in head, and very slender. Color in alcohol very dark steel blue above, becoming paler below, nearly white anteriorly on belly where only the margins of the scales are punctate; no silvery anywhere; lower jaw dusky, a large black blotch on cheek between suborbital and premaxillary. Sides, back, top of head, dorsal and caudal fins with few small dark spots; pectorals dusky, slightly spotted at base; anal slightly dusky, without spots; ventrals dusky with a few spots in middle; adipose fin with a few spots; lower fins all tipped with pale, probably yellowish red in life. Spots all very small and faint, not confined to posterior part of body.

The specimen before us, No. 1863, L. S. Jr. Univ., is a male, $18\frac{1}{4}$ inches long. It was taken at Fairholme on Lake Crescent, Clallam county, Washington, March 12, 1896, by Mrs. G. E. Mitchell of Fairholme.

The following account of Lake Crescent is given by Mr. M. J. Carrigan:

"Lake Crescent, from which the blue-backs are taken, is about twenty miles from Port Angeles, and is a most beautiful and prolific body of water. It is in the Olympic Mountains, is seven hundred feet above the level of the sea, and in size is about ten miles long by two miles wide. It is very deep, many hundreds of feet in places, and its waters are very cold. Its water supply comes in large part from the snow from the mountains which rise from its shores in great majesty and almost completely surround it. The fishing there is really magnificent, especially fly-fishing. Several varieties of trout abound, but the blue-back is the handsomest and gamest fish in the lake. They afford one great sport. Those that the Admiral took measured from twenty-eight to thirty-two inches in length, and averaged about ten pounds each in weight. He has doubtless furnished you with exact data regarding his fine catch there.''

5. **Salmo gairdneri beardsleei** Jordan & Seale, n. subsp.
BLUE-BACK TROUT OF LAKE CRESCENT. Plate xxiii.

Head $3\frac{4}{5}$ in length to base of caudal; depth about 4; eye $4\frac{5}{6}$ in head, $1\frac{2}{5}$ in snout; scales 24–130–20, 130 cross series, those in front of dorsal numerous, about seventy if counted along median line, sixty if the rows along upper side are counted; dorsal with 10 branched rays; anal with 11 branched rays; branchiostegals 11; gill-rakers 8+13, rather long and slender, the longest nearly $\frac{5}{16}$ inch in length, 7 to 9 in maxillary. Head pointed; mouth rather large; maxillary extending to hinder margin of eye, $1\frac{4}{5}$ in head, with about 20 teeth; snout $3\frac{3}{5}$ in head; preorbital very narrow, the maxillary almost touching the orbit; posterior suborbitals shorter than eye, about 6 in head; opercle not very broad, equal to eye, its free part $4\frac{5}{6}$ in head; interorbital width $3\frac{3}{5}$ in head, equal to snout; several large teeth along margin of tongue; no hyoid teeth; teeth on vomer in zigzag series. Origin of dorsal in middle of the length, margin slightly concave, the first ray $1\frac{5}{6}$ times last, the last ray being pointed, slightly greater than base, $2\frac{1}{10}$ in head. Origin of anal midway between origin of dorsal and base of caudal, margin straight, the tip of the last ray slightly exserted; anterior rays 3¼ times posterior, and equal to base of fin, 2⅓ in head. Adipose fin high and slender, situated above or anterior to end of anal. Pectorals 1½ in head; ventrals under middle of dorsal, 2⅓ in head. Caudal broad, nearly truncate, the middle portions abruptly lunate when spread open, with pointed angles, each lobe being somewhat convex on its edge; longest rays 1⅓ in head. Least depth of caudal peduncle 2¾ in head. Pyloric cœca 50 to 60, short and thick, the longest about 3 in head. Color in spirits very dark blue above, sides abruptly brighter, with many scales abruptly silvery; below white, lower jaw white, its margin dusky; cheeks below suborbitals very dark; sides, top of head, dorsal and caudal fins spotted, the spots all very small; pectorals and ventrals nearly colorless, without spots, and slightly dusky; adipose fin with two spots; tips of lower fins faintly tinged with yellowish.

Two specimens, each 16 inches long, Nos. 1861 and 1862, L. S. Jr. Univ. They were taken on March 12 and 16, 1896, in Lake Crescent, by Mrs. George E. Mitchell of Fairholme, and sent to us by Mr. M. J. Carrigan of Port Angeles. No. 1864, L. S. Jr. Univ.

A third specimen of much larger size, afterwards sent to us, shows the following characters:

Head 3⅝; depth 3⅔; D. 12; A. 12 branched rays; branchiostegals 11 or 12; scales 23–123–26, 64 before dorsal; snout 2⅝; eye 7⅔; maxillary 1⅔ in head, its depth 8 in its length.

Body robust, little compressed; head large, maxillary moderate, extending beyond eye; opercle moderate, its width 5⅔ in head. Last ray of dorsal pointed. Caudal subtruncate, lunate mesially, each lobe somewhat convex, pointed at tip. Caudal peduncle short and thick. Series of vomerine teeth long, in double row. Color above dark green, with black spots which are small and sparse on body, extending to below lateral line; many small spots on head, dorsal and caudal; spots not more numerous behind than before; sides and belly bright silvery; no red on lower jaw; a faint pink shade along lateral line; pectorals colorless except the upper ray; ventrals and anal colorless; flesh pale; gill-rakers removed.

This specimen, male, was taken in Lake Crescent. Length 26½ inches; weight in life 14 pounds.

This specimen differs from a large *gairdneri* most in the large scales. In addition the head is much larger, and the body deeper.

A fourth still larger specimen (No. 1865, L. S. Jr. Univ.), an old spent male, 27 inches long, has been still later received. It shows the following characters:

D. 11; A. 12. Head $3\frac{3}{5}$ in length. Gill-rakers 8+12, of medium size, rather broad but sharp pointed; opercle 3½ in head; eye 7 in head; B. 11. Maxillary long, reaching beyond the eye, 1⅔ in head, its width 9½ in length. A double row of sharp teeth extending to within a short distance of end, where they are replaced by a single row of slightly larger teeth; teeth on tongue rather large; no teeth on hyoid; teeth on vomer in zigzag series. Scales 26–137.

This specimen, a spent male, has the flabby muscles and slimy half concealed scales of the spent male salmon. The dark dots are very numerous and small and show very distinctly on back and sides, as also on head and fins. There is a dull red lateral band on head and body. This is about an inch broad, its outlines diffuse: A black blotch on cheek; maxillary dusky with a red blotch toward its tip. Lower jaw and branchiostegals dusky; pectoral, ventral and anal dark; back dark green, belly dusky.

The following account of the life-coloration of *Salmo beardsleei* is given by Mr. George E. Mitchell.

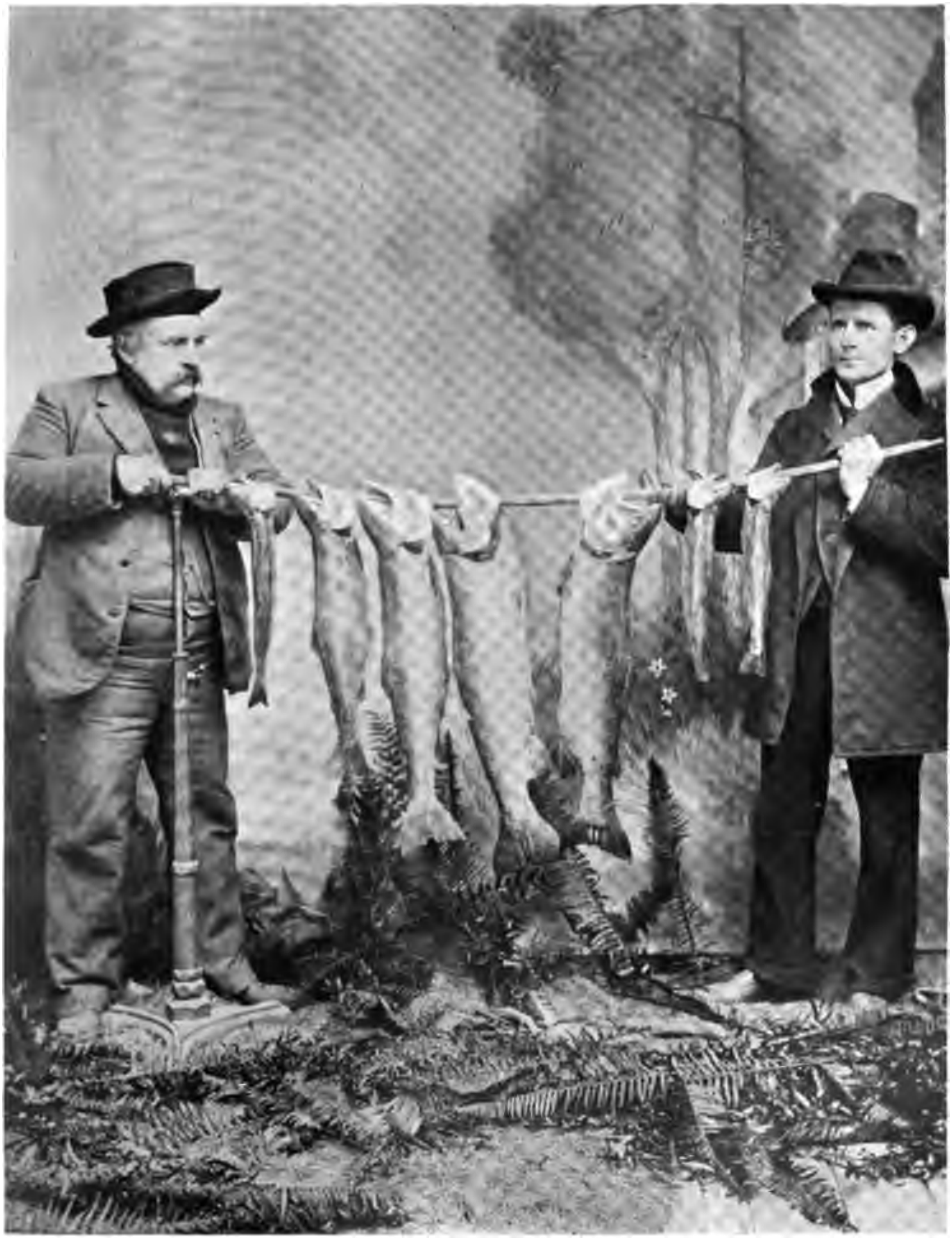
"The Blue-back Trout caught in Lake Crescent are on the back a deep dark-blue ultra-marine color of a peculiar transparency, dotted with small round black spots from the size of a pin's head to a little larger. The two fins on the top of the back are a dark smoky color, also dotted as on back end and are transparent. The tail is the color and transparency with dots also—same as the top fins. The side fins and the bottom fins are dead white and sometimes faintly tinged with a pinkish hue at the edges; the belly is white. Looking at the fish sideways the sides of the fish show the scales to be iridescent, the red flash predominating. The head has very much the polish of mother-of-pearl around the lower jaws and jowls, red and pale blue colors predominating; under the eyes a few black spots; on top of head the blue much darker than on top of back—so dark in fact that the black spots on it look blacker than the rest. The nearer the shore these fish are caught the lighter the blue on back, the fish often having an impression of the surroundings distinctly marked on them."

The following notes are added by Admiral Beardslee:

HABITS.

The Blueback is a deep water dweller; those taken by me in late October were caught at depths varying from 30 to 50 feet, on large spoons. They fought hard until brought near surface, then gave up, and when landed were found puffed up with air. Specimens taken in spring and put in pools in mountain streams with other trout died very soon, while the others lived. The trout caught by Mr. Mitchell, in March, was taken near bottom, by a large spoon, and it is not on record that at so early a date one has previously been caught.

BLUEBACKS FROM LAKE CRESCENT, WASHINGTON.



L. A. BEARDSLEE. 6 11½ 11 11¼ M. J. CARRIGAN.

TWO HOURS' WORK, OCTOBER 28, 1895.

FLESH.

Light lemon color before cooking; devoid of the oily salmon flavor, and very excellent; whitening by cooking.

OVA.

October 28—The eggs in the large fish were in *individual* size, and in size of cluster much smaller than those of a salmon of the same size.

The following extracts from a letter from Mr. Carrigan, dated Port Angeles, April 30th, are of much interest:

* * * Answering your direct inquiries: The Beardslees and Crescents are readily distinguishable, and can always be told apart.

There are no red spots at the points indicated on the Crescent trout—no markings to suggest the Cut-throat trout.

There are no Cut-throat trout in Lake Crescent.

The Beardslees (Bluebacks) are taken in deep water. Those caught by the Admiral and myself were taken in from 25 to 35 feet of water.

The known varieties of trout in the lake. are:

(a) "Beardslees."

(b) "Crescents."

(c) "Silvers" (the local name for a very beautiful trout, that measure, as a rule, from 12 to 18 inches in length; but I have seen specimens 22 inches long, and there are doubtless much longer ones in the lake).

(d) "Half-breeds" (the local name for a long, slender, graceful trout, that seems to be a cross between the Beardslees and Crescents. The markings of the fish, as I recall them after last season's fishing, are a rather pale olive-green back and silver sides; the head and back being dotted with rather faint small black spots. The shape of the fish is one of its distinctive features. The flesh is pale lemon colored).

(e) "Mountain trout" (a variety that evidently comes into the lake from the mountain streams that empty into it).

The possibilities of the beautiful mountain lake have never been fully tested. The Admiral (Beardslee), when he comes up in June, will fish it at all depths, and there is no telling what new surprises he may bring forth. The lake is about 10 miles long by 2 or 2½ miles wide, and deep water is found everywhere close to shore. In places a 500 foot lead-line will not sound bottom. No one really knows what depths of water exists in the lake beneath the 500 foot sounding, or what size or variety of trout can be taken at depths lower than those so successfully tried by Admiral Beardslee. But we will know this season; and you will be promptly acquainted with everything new or of interest that is brought forth.

* * * High up on the side of one of the mountains surrounding the lake—probably 2,500 or 3,000 feet above the lake—is a pretty little lake containing what I believe will also prove a new variety of trout. Specimens of the variety are found every spring, after the freshets caused in the mountain streams by melting snow, floating on the surface of Lake Crescent, dead. They are evidently carried out of the little lake by the torrent and are battered to death in going over the falls in the creek, for streams empty into the little lake that have their origin up near the crest of the mountain. Mrs. Carrigan found one of these trout floating on Lake Crescent about ten days ago. It was still alive, but died directly after being taken into the boat. Its head and body were all bruised and battered, and its tail fin was broken and in shreds. It may be that the little lake is the home for what we, for want of a better name, call Half-breeds. We will go up to the little lake this summer, and secure some good specimens of the trout it contains. * * *

In a letter to Admiral Beardslee, dated April 19th, Mr. Carrigan gives these further details, especially interesting to the angler:

* * * I have some news that will interest you. We have a young lady friend visiting us—Miss Sara Beazley of Columbia, Missouri. On Friday, the 17th inst., Mrs. Carrigan and Miss Beazley drove out to Lake Crescent to spend a few days with Mrs. Mitchell. They returned in triumph at 4 o'clock this afternoon, with four trout weighing 21 pounds.

Miss Beazley, Mrs. Mitchell and Mrs. Carrigan went out fishing at 10:30 yesterday, Saturday morning, April 18th. They took the copper wire troll that you sent to Mrs. Mitchell and Miss Beazley did the fishing, using trout belly for bait. When off Eagle Point, at 11:30, Miss Beazley caught and successfully landed a magnificent speckled trout that measured 27 inches in length, was 6 inches through, and weighed 8 pounds. The top of the head and back of the fish is a dark blackish green, the head and back being thickly covered with quite large round black spots which extend down the sides about halfway to the median line. From there to the median line the black spots are equally thick, but are irregular in form, two and sometimes three spots lapping on to each other, making angular looking black spots of various sizes, some of them quite large. The irregular spots extend in a scattering way below the median line. The tail is thickly marked with round black spots.

The upper jaws and gill plates have the appearance of clouded reddish mother-of-pearl, somewhat iridescent. In some lights the "reddish" shade has a burnished copper effect, and in other lights it presents a pale magenta shade. There are six large round black spots on each side of the head, on the upper and back portion of these mother-of-pearl plates (on a line back of the eyes). The back fins are blackish green, heavily dotted with round black spots. The side and belly fins are of smoky gray, opaque, and entirely free of spots.

Miss Beazley had a great struggle landing the fish. It made a fine fight, towing the boat for a long distance. She landed him without a gaff-hook.

About an hour later in the same locality Miss Beazley caught a one-pound Bearsdslee. The party then went home to luncheon, and at 4:30 started out again, Miss Beazley still managing the troll, and Mrs. Mitchell managing the boat. At 6:30 o'clock, when off Eagle Point, Miss Beazley caught and landed (without a gaff, also) a superb Beardslee that measured 29½ inches in length and 8 inches through, and weighed strong 10 pounds. It was a beautiful specimen and made a fierce and prolonged fight. It raced along with the boat (the wind slight favoring its "tow") for a long distance below the point, and made several desperate and out-of-the-water leaps and plunges to get away; but it had swallowed the hook and was securely caught. As soon as it struck the bottom of the boat, on being taken over the side, it began a terrific struggle to get back into the water, and both Miss Beazley and Mrs. Mitchell had to throw themselves upon him and hold him down with their knees. When he was finally killed and the hook removed, it was found that in his struggle for freedom he had badly bent the shank between the spoon and the hooks; but it held fast, to the delight of the three ladies, who made the lake ring with their exultant exclamations. I don't suppose there ever were three happier women.

On their way home, Miss Beazley landed a beautiful two-pound Crescent.

Both of the big trout were caught just as the wind freshened into a strong breeze, and were taken in from 30 to 35 feet of water. The women followed the plan of rowing along slowly; stopping rowing altogether for a few seconds, and then starting off again slowly. Both fish were taken just as the boat started up, after one of three brief stops, during which the troll had gone down to a greater depth than when the boat was in motion.

I examined the Beardslees with great care just after the women reached home this afternoon, and have settled these points definitely: The head is densely spotted with round black spots down as far as the mother-of-pearl gill plates, but no further. There are no black spots on these plates. The blue on the back extends down almost to the median line, and the entire back, from head to tail, and on either side halfway down to the median line, is thickly marked with round black spots which decrease in size as the tail is approached. The tail itself is densely dotted with round black spots, as are also the back fins. The side and belly fins are not spotted. The black spots on the back are not so prominent as on the smooth surface of the head, owing to the presence of the scales on the back and sides, but they are there in great numbers.

I noticed this difference between the marking of the one-pound and the ten-pound Beardslee. On the one-pound fish there is a well-defined line of large round dark spots extending the whole length of the body, from a point just back of the gills to the tail fin, and midway between the median line and the bottom of the belly. There are 17 of those spots grading down in size. These spots are not a pronounced black, but show out plainly enough from beneath the whitish silver scales, presenting the dark dull appearance of human flesh bruised by a blow. These spots are entirely absent from the ten-pound Beardslee.

* * * On Friday, April 17th, just before Mrs. Carrigan and Miss Beazley arrived at the lake (it was about 6 o'clock in the afternoon) Mrs. Mitchell caught, with the gear you sent her, a twelve-pound Beardslee, measuring 30 inches in length and 8½ inches through. She is immensely proud of your gift, which is doing such splendid work so early in the season.

These fine catches made by the ladies prove the possibilities of the lake in early spring; your own splendid success demonstrates what can be done late in the fall, at the very tail end of the season. It remains for you to show what can be done in the heat of the season. There is no knowing what surprises may result from the deep fishing that you will do this summer, for I know that you will give the lake a thorough test at all depths.

It would be a good idea to take out, when you go there this summer, a proper rig for sounding the lake, which has never yet been sounded.

It is my conviction that you will shatter your own big trout record all to pieces this summer, and give the fishing world a series of fresh surprises.

* * * The Eagle Point stream has its origin in a little lake high up on the mountain side, probably 2,000 feet above Lake Crescent. There is a high and very pretty water-fall in the stream. On the mountain side of the little lake are trout, and the fish the ladies picked up on Crescent Lake evidently came from this little lake, being battered to death in coming over the fall. The men who run the launch say that the spring freshets bring down large numbers of trout from this little lake, and that many of them are killed in the descent.

In a letter to me, dated May 5, 1896, Mr. Carrigan gives further notes of interest concerning the third specimen described above:

I have just forwarded to you a 14-pound "*Crescent Lake trout*" (the Blueback), which was caught at Lake Crescent, Sunday afternoon, by Mr. Ben. Lewis. This trout, when taken from the water, weighed full 14 pounds, measured 32 inches in length and 8½ inches in width. Mr. Lewis at once started for Port Angeles, to present the trout to me to be forwarded to you, for I had told him that I was anxious to send you a large specimen of the Crescent trout, that you might note its special characteristics. He rowed over the lake, 8 miles, and walked into Angeles, 20 miles more, carrying this trout on his back, arriving here at midnight. We were both desirous of getting the fish off to you as promptly as possible and in the best condition, but it was impossible to get any ice here yesterday, and we had to keep the trout as best we could until the ice we telegraphed for arrived from Seattle to-day.

It is a magnificent specimen of the "*Salmo beardsleei*," and certainly presented a splendid appearance when first unrolled from Mr. Lewis' pack-sack. It was then sweet, fresh and plump. I hope it will reach you in good condition. We packed it carefully in ice before sending it forward.

It is a pity that we cannot get one of these fish to you, showing its beautiful life coloring. When freshly taken from the water the head and back of the trout is a very deep, rich blue, which extends well down to the median line, and below the median line all is gleaming, creamy white, with a sheen as bright as burnished silver, and iridescent. The head, back and tail are strongly marked with black spots.

The beautiful blue coloring of the back fades out after death and loss of blood, and changes to a shade of silvery green. I don't know what the fish look like when they reach you, but they have lost their royal coloring before they leave here.

Mr. Lewis has just told me of an entirely new variety of trout that he catches in the lake, at a depth of from 80 to 100 feet. He takes them on set lines, which he places out over night, and says he has never been able to catch one of this species in any other way. He says it differs from any other trout in the lake; that it is a long, slender, graceful and very attractive fish, with a grayish green back and below the median line, pure white sides and belly. He has promised to secure a specimen of this variety for me to be sent to you.

Family LUTIANIDÆ.

6. **Xenocys jessiæ** Jordan & Bollman. Plate xxiv.

Xenocys jessiæ Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 160. Charles Island, Galapagos.

The figure of this handsome species is taken from one of the original types.

Family SCIÆNIDÆ.

7. **Umbrina sinaloæ** Scofield, n. sp. Plate xxv.

Head $3\frac{9}{10}$; depth $3\frac{6}{10}$; eye 3¾ in head; snout 3⅓; interorbital space 4¼; tip of snout to end of maxillary 2½; D. X–I, 28; A. II, 6; scales 7–51–10; (scales 7 between front of dorsal and lateral line, 10 between line and vent; 51 pores in lateral line to base of caudal); pectorals $1\frac{3}{5}$ in head; ventral $1\frac{2}{5}$; second anal spine 2¼; third dorsal spine longest, 1⅔ in head; gill-rakers 6+9, rather slender, about ½ as long as pupil; distance to anal 1½ in length (1⅓ in *xanti*); barbel slender; caudal slightly lunate, the upper lobe the longer. Color dark above (greenish in life), silvery below; a dark blotch on opercle; conspicuous dark olive stripes follow the center of the scale rows upward and backward on the sides and back; stripes about ½ as wide as pupil; spinous dorsal dusky; ventrals and anal pale, without punctulations; lining of gill cavity quite dark; gill membranes pale; peritoneum pale.

Resembles *Umbrina xanti* very closely; but is distinguished by the dark gill cavity, the small scales, small second anal spine, and more anterior position of anal. The stripes on the body are slightly darker, not so undulating, and there are a few more of them, due to the smaller and more regular scales.

Length 8 inches.

Type No. 1632, L. S. Jr. Univ. Mus., collected at Mazatlan by the Hopkins expedition of 1894. Several specimens were obtained in company with *Umbrina xanti*. It is equally abundant, having been hitherto confounded with the latter species. I may note that specimens of the Californian species, *Umbrina roncador*, are in the collection from Guaymas.

Family SCORPÆNIDÆ.

8. **Emmydrichthys vulcanus** Jordan & Rutter, n. gen. and sp. Plate xxvi.

Generic description:

Body short and stout, length of head about equal to depth; body with no scales, thickly covered with irregular dermal prominences. Cleft of mouth vertical. A band of minute depressible teeth in each jaw, none on vomer or palatines. Tongue free, short and broad. Opercles unarmed, covered with thick loose skin. Gill openings very long. Eyes with an almost vertical range, the interorbital space very deep, a large pit behind and one below each eye. Dorsal divided by a deep notch, the anterior part with nine, the posterior with two spines; anal with three. Anterior spines of dorsal each with a pair of antero-lateral grooves.

The new genus *Emmydrichthys* is closely related to *Synanceia* Bloch, differing in having the dorsal divided and with a smaller number of spines, and in the presence of a deep pit or groove below eyes.

Head 2⅓ in length, depth 2⅓. D. IX–II, 7; A. III, 6; P. 18. Gill opening extending forward almost to below mouth, almost as long as depth of body. Head with many pits and irregular protuberances. Eyes situated on the outer sides of a pair of protuberances, the interorbital space very deep and nearly smooth, a large cavity behind each eye and a smaller one below. A small papilla on upper side of eyeball. Jaws equal, fringed with cirri. Anterior nostril tubular. Dorsal fins connected at base. Fin membranes all thick and heavily papillose, greatly thickened around anterior dorsal spines. Eyes midway between snout and origin of dorsal. Middle dorsal spines slightly longest, about equal to distance of first spine from pupil; longest pectoral rays, third and fourth from top, equal to distance of dorsal from tip of lower jaw; anal not so high as soft dorsal; caudal small, rounded, shorter than ventrals; ventrals with two-thirds of inner side grown to body. Color, in alcohol, nearly entirely jet black, the tips of the warty processes on head washed with white, and some minute whitish streaks on under edge of eye.

This specimen, in color and appearance, bears an astonishing resemblance to a lump of black lava.* This is undoubtedly a matter of mimicry, and its native haunt must be among volcanic rocks.

The type specimen, 9½ inches long, was sent to the museum of California College, Oakland, by Rev. J. H. Henry of Tahiti. It was said to have been taken at the Hawaiian Islands. By the courtesy of Professor Inskeep of this institution we have been permitted to examine this type. The species is called by the natives No-ho, and its poisonous dorsal spines cause it to be greatly dreaded.

---

* Hence the name from μύδζος, a lump of lava.

Family COTTIDÆ.

9. **Cottus annæ** Jordan & Starks, n. sp. Plate xxvii.

Head 3½ to 3¾ in body, depth 5. D. VII or VIII-16 or 17; A. 12; eye 5 in head; maxillary 3⅔; highest dorsal spine 3½; highest soft ray 2; pectoral 1; ventral $1\frac{3}{8}$; caudal 1¼.

Body elongate, not much compressed; caudal peduncle wide, wider than length of snout. Head small, broadly rounded anteriorly as viewed from above; snout blunt as viewed from the side; mouth very small, without so much lateral cleft as in *Cottus beldingi* or *C. philonips*, the maxillary reaching to front of pupil; teeth in moderately wide bands on jaws and vomer; palatines toothless or with a few teeth in a narrow band on front; interorbital (bone only) equals ½ eye; eye smaller than length of snout; preopercle with only one small blunt spine, below which its edge is entire. Pectoral barely reaching front of anal; spinous dorsal very low, from ½ to ⅔ as high as soft dorsal, its base from its first spine to first ray of soft dorsal 1¼ in head; dorsals barely meeting, not at all connected.

Color light gray, somewhat mottled; ventrals and anal colorless, other fins crossed with wavy lines; a black spot on each end of spinous dorsal.

We have compared these specimens with specimens of *Cottus beldingi* from Birch Creek, Idaho, and from other localities as also with a single type specimen of *Cottus* *philonips* from Field, B. C. It differs from both of these in having the mouth and eyes smaller, and from the Field specimen in having a deeper body.

Here described from four specimens from 2½ to 3½ inches in length, collected at Gypsum, Colorado, from the Eagle River, by Jordan, Evermann, Fesler and Davis, Nos. 1305, 1308, 1309 and 1310, L. S. Jr. Univ. Mus. It has hitherto been confounded with *Cottus semiscaber*, which was taken in abundance at the same place, and recorded in their report as "*Cottus bairdii punctulatus.*" The species is named for Miss Anna Louise Brown, artist of the Hopkins Laboratory.

We may here note that *Cottus philonips* is very doubtfully distinct from *Cottus beldingi*, the only difference we can find being in the deeper body of the latter, which is a widely distributed species. Of *Cottus philonips* only the types are yet known, the Alaskan specimens referred to it being quite distinct.

10. **Cottus shasta** Jordan & Starks, n. sp.

Head 3 to 3⅓ in body, depth 4½. D. VIII or IX–17 or 18; A. 13 to 15; eye nearly 5 in head; maxillary $2\frac{1}{5}$; third or fourth dorsal spine $3\frac{3}{5}$; highest soft ray about 2; pectoral about $1\frac{1}{10}$; caudal 1¼.

Body not much compressed; caudal peduncle rather wide, about equal to snout; mouth rather large, the maxillary reaching to posterior margin of pupil; teeth in a moderate band on jaws and vomer, in an exceedingly narrow band in front of palatines; interorbital space not much over half eye; upper preopercular spine short, not much hooked up and not very sharp; a shallow concave space between it and the second, scarcely a notch; the second small and sharp, the third but slightly developed. Pectoral reaching to below the fourth ray of soft dorsal; ventrals not reaching the vent; dorsals scarcely con nected, the soft dorsal high, the highest rays equal to eye and snout; vent slightly nearer tail than tip of snout. Skin smooth, except a few scattered prickles under pectorals.

Color very dark brown or blackish; sides mottled; top of head uniform blackish; all the fins more or less mottled, ventrals white or dusky. The following is the fin formula of four specimens:

Dorsal	IX–17;	VIII–19;	IX–17;	IX–18.
Anal	14;	15;	15;	13.

Upper Sacramento Basin; here described from four specimens from McCloud River, Baird, Shasta county, California, about 4 inches in length. No. 4196, L. S. Jr. Univ. Mus. Collector, E. C. Starks.

The species is very close to *Cottus semiscaber*, but it has a longer anal.

11. **Tarandichthys filamentosus** (Gilbert). Plate xxviii.

Icelinus filamentosus Gilbert, Proc. U. S. Nat. Mus., 1890, 85. Off Santa Barbara Islands.

The section of *Icelinus* distinguished by the presence of filamentous dorsal spines, and the presence of bony plates behind the pectoral, represents a subgenus or genus distinct from *Icelinus*. This may be called *Tarandichthys*, Jordan & Evermann. The name (*Ταράνδος*, reindeer) alludes to the antler-like preopercular spine. The accompanying plate is from one of the type specimens of the type-species, *filamentosus*.

12. **Icelinus quadriseriatus** (Lockington). Plate xxix.

We present for comparison a figure of the type-species of *Icelinus* from a specimen dredged off the coast of California.

13. **Oligocottus borealis** Jordan & Snyder, n. sp.

Head $3\frac{1}{6}$ in length; depth $4\frac{1}{3}$; dorsal VIII or IX–16 or 17; anal 12 to 14; pectoral 14; orbit 4 in head; snout 4; maxillary $2\frac{4}{5}$; highest dorsal spine 3; dorsal ray $2\frac{1}{5}$; caudal ray $1\frac{1}{2}$; first anal ray ♀ $1\frac{1}{2}$, ♂ 3; ventrals $1\frac{5}{6}$; caudal peduncle $3\frac{1}{2}$; pectorals 3 in length.

Body compressed, elongate; back somewhat elevated, deepest below middle of spinous dorsal. Head almost as wide as long, tapering from behind to the somewhat pointed snout; profile of head rounded above, straight below; mouth terminal, nearly horizontal; maxillary extending to vertical through posterior part of pupil; lower jaw included; jaws, vomer and palatines with villiform teeth; snout as long as orbit; eye high in head; interorbital space narrower than width of orbit; its concavity angular; opercle with a triangular flap; angle of preopercle produced into a forked spine, which is covered with skin, except on the sharp points; prongs of preopercular spine half as long as orbit; nasal spines prominent; the long premaxillary processes form a sharp ridge between the latter; branchiostegal membranes forming a fold across the isthmus; gills $3\frac{1}{2}$, the slit behind the fourth arch much reduced; pseudobranchiæ present; gill-rakers represented by a few protubrances on the arch.

Skin smooth. Filaments on free end of maxillary, on inferior edge of preopercle, and from first dorsal to the bases of the pectoral fins; also a row of filaments extending along the supraorbital crest, over the back of the head and along the lateral line for about half the length of the body; the filaments are usually paired, *i. e.*, two grow from the same place. Anal papilla prominent. Large mucous pores are scattered about the top and sides of head; pores of lateral line 36 to 40.

Dorsal fins two, separate; first dorsal 4 in head and body, curving from distal end of first spine to posterior part of base; spines rather feeble; second dorsal 2 in head and body, a little higher than first, its middle rays longest. Anal fin about 3¼ in head and body; in the male the first and second rays longest, the third, fourth and fifth each a little shorter than the preceding one, the last shortest. In the female the first ray is the shortest. Caudal fin somewhat rounded. The pectoral rays below the sixth are ventrally free from the connecting membrane for a portion of their length. Ventral fins reaching to vent, in some specimens to anal.

Color usually reddish brown, varying to gray, intense green or crimson, according to surroundings, the colors developed in the presence of similarly colored algæ; dorsals, pectorals and caudal barred; anal sometimes barred; front of spinous dorsal with an ocellated black spot.

The types were collected in the tide pools at Neah Bay, Puget Sound, by Mr. E. C. Starks. Very many specimens are in the Leland Stanford Jr. University collection, No. 3396. Others were earlier sent to us by Henry St. Clair of Neah Bay. Still others were taken by Dr. Gilbert at Departure Bay, Vancouver Island.

This species is closely related to *Oligocottus maculosus*, with which it has been hitherto confounded. It is distinguished from the latter by having fewer filaments on the head and body, an ocellated spot on front of first dorsal, and by having the rays of the anal fin in the male all connected by membrane; the first ray of anal is much shorter and weaker in *borealis*.

14. **Ulca marmorata** (Bean). Plate xxx.

Hemitrepterus marmoratus **Bean, Proc. U. S. Nat. Mus., 1890, 43. Sitkalidak Island.**

This species differs from *Hemitripterus* in the shorter first dorsal, which does not show the division found in the typical species of *Hemitripterus*. It is the type of the genus, *Ulca*, Jordan & Evermann. The specimen figured, not a type, is from near Unalaska. Coll., C. H. Gilbert, on the Albatross.

Family GOBIIDÆ.

15. **Eleotris abacurus** Jordan & Gilbert, n. sp.

Head 3; depth 4⅓. D. VI–9; A. I, 8; scales 51–20; eye 8 in head, 2⅓ in interorbital width; pectoral 1⅓; ventral 1½; highest dorsal ray 2; highest anal ray 2; caudal 1¼.

Body slender, compressed, the head depressed, becoming very narrow anteriorly, its width ⅗ its length; a notable depression above orbits, the premaxillary processes protruding before it; lower jaw the longer; maxillary reaching vertical behind pupil, 2⅗ in head. Teeth in jaws in narrow villiform bands, becoming a single series on sides of lower jaw; those of the outer and inner series in each jaw are somewhat enlarged, the largest being a single series in sides of lower jaw. Preopercular spine as usual in the genus. Scales smooth above and below, ctenoid on sides.

Color in spirits brown, lighter above and below; each scale on middle of sides with a dusky streak, these forming obscure lengthwise lines; back anteriorly with a few small black spots; under parts, including sides of head, very thickly punctulate with black; no dark stripes from orbit. Lips black; a dark streak from snout through eye to upper angle of preopercle; two dusky streaks from eye downwards and backwards across cheeks; a very conspicuous black blotch as large as eye in front of upper pectoral rays. Pectorals and ventrals transparent, dusky; vertical fins all barred with light and dark in fine pattern.

Coast of South Carolina; known from a single specimen, 4 inches long, No. 2009, L. S. Jr. Univ. Mus.; taken in the harbor of Charleston, by Dr. Gilbert.

This species agrees very well with Cope's account of *Culius amblyopsis*, but the eye is smaller and there is some difference in color, besides the remote habitat.

16. **Evermannia longipinnis** (Steindachner).

Gobiosoma longipinnis Steindachner, Ichth. Beitr., viii, 27, 1879. Las Animas Island, Gulf of California.

At my request, Dr. Steindachner has re-examined the types of his *Gobiosoma longipinnis*. He finds them completely scaleless, as originally described. The species cannot then be placed in the genus *Clevelandia*, as in Dr. Eigenmann's arrangement, but is nearest to *Evermannia*.

17. **Clevelandia rosæ** Jordan & Evermann, n. sp.

Clevelandia longipinnis, Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 1888, 73. San Diego. Not *Gobiosoma longipinne* Steindachner.

The species described from San Diego by Dr. and Mrs. Eigenmann, under the erroneous name of *Clevelandia longipinnis*, and made the type of the genus *Clevelandia*, must receive a new name. We suggest that of *Clevelandia rosæ*, in honor of Mrs. Rosa Smith Eigenmann, its discoverer.

Family URANOSCOPIDÆ.

18. **Kathetostoma averruncus** Jordan & Bollman. Plate xxxi.

Kathetostoma averruncus Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 163, southwest of Panama.

A figure of this interesting species of Star Gazer is here given from the original type.

Family DACTYLOSCOPIDÆ.

19. **Gillellus semicinctus** Gilbert. Plate xxxii.

Gillellus semicinctus Gilbert, Proc. U. S. Nat. Mus., 1890, 98. Gulf of California.

I present a figure of this interesting species from one of the types.

20. **Dactylagnus mundus** Gill. Plate xxxiii.

I present a figure of this species from a specimen obtained by Dr. Gilbert while with the Albatross. The genus is a valid one, well separated from *Doctyloscopus*.

Family GOBIESOCIDÆ.

21. **Bryssetæres pinniger** (Gilbert). Plate xxxiv.

Gobiesox pinniger Gilbert, Proc. U. S. Nat., 1890, 94. Puerto Refugio, Gulf of California.

This species is the type of a distinct genus, *Bryssetæres* Jordan & Evermann, distinguished from *Gobiesox* by the long dorsal fin. The vertebræ are 26, as in *Gobiesox*. The plate here given is from one of the type specimens. The name βρύσσος, sea-urchin; ήταίρος, comrade, alludes to the brotherhood existing between the Clingfishes and the Sea-urchins in the rock pools.

22. **Arbaciosa humeralis** (Gilbert). Plate xxxv.

Gobiesox humeralis Gilbert, Proc. U. S. Nat. Mus., 1890, 95. Puerto Refugio.

This species, with its allies *zebra*, *eos*, *rhessodon*, etc., differs from *Gobiesox* in the serrated teeth. It may be made the type of a distinct genus, *Arbaciosa* Jordan & Evermann.

The name is given in allusion to the close association in the rock pools between the Sea-urchins and the species of this genus. This relation is especially close between the Sea-urchin, *Arbacia stellata* and *Arbaciosa zebra*.

23. **Arbaciosa rhessodon** (Rosa Smith). Plate xxxvi.

I present a figure of this interesting species from a specimen from San Diego.

24. **Arbaciosa eos** (Jordan & Gilbert). Plate xxxvii.

I here present a figure of a specimen from Mazatlan.

25. **Rimicola muscarum** (Meek & Pierson).

Gobiesox muscarum Meek & Pierson, Proc. Cal. Ac. Sci., 1895, with plate. Monterey.

This species is distinguished from *Gobiesox* by the narrow body and very small dorsal and anal fins. It may be regarded as the type of a new genus, *Rimicola* Jordan & Evermann. To the same genus, *Gobiesox eigenmanni* Gilbert may be referred. *Rimicola muscarum* has been well figured by Meek & Pierson.

26. **Rimicola eigenmanni** Gilbert. Plate xxxii.

I present a figure of the type of this species from Todos Santos Bay.

Family BATRACHOIDIDÆ.

27. **Thalassophryne dowi** Jordan & Gilbert. Plate xxxviii.

Thalassophryne dowi Jordan & Gilbert, Proc. U. S. Nat. Mus., 1887, 388. Panama.

I present a figure of this interesting species, taken from a specimen from Panama, larger than the original type.

I may notice that *Batrachus* Bloch & Schneider, 1801, is a synonym of *Batrachoides* Lacépède, 1800, and cannot be used as the name of a distinct genus. None of the naked Toad-fishes were known to Schneider. The oldest generic term available for them is that of *Opsanus* Rafinesque, *Opsanus cerapalus* is identical with *Batrachus tau*, which must stand as *Opsanus tau*.

Family BLENNIIDÆ.

28. **Starksia cremnobates** (Gilbert).

Labrisomus cremnobates Gilbert, Proc. U. S. Nat. Mus., 1890, 100. Gulf of California.

This pretty species seems to be the type of a distinct genus, *Starksia* Jordan & Evermann, distinguished from *Labrisomus* by the large scales, presence of palatine teeth, the short, soft dorsal and the absence of the comb of nuchal filaments. It is named for Mr. Edwin Chapin Starks, in recognition of his work on the fishes of the Pacific Coast.

29. **Exerpes asper** (Jenkins & Evermann).

Auchenopterus asper Jenkins & Evermann, Proc. U. S. Nat. Mus., 1888, 154. Guaymas.

The widely separated and ribbon-like first dorsal fin, formed of three close set spines, may distinguish *asper* generically from the other species of *Auchenopterus*. The genus *Exerpes* Jordan & Evermann, based on it, is further distinguished by the long, sharp snout, and the long ventrals. The species has been well figured by Jenkins & Evermann. (Proc. U. S. Nat. Mus., 1891; plate II.)

30. **Chasmodes jenkinsi** Jordan & Evermann, n. sp. Plate xxxix.

Hypsoblennius striatus Evermann & Jenkins, Proc. U. S. Nat. Mus., 1891, 163, Guaymas, not of Steindachner.

Head 3⅓ (4 in total); depth 4 (5). D. XII, 17; A. 18 or 19; eye 4 to 5 in head.

Body more robust than in related species, resembling *Hypsoblennius*; head large, gently rounded in profile, the snout steep, 4 in head; interorbital space narrow, grooved; orbital tentacle (male) much as in *Hypsoblennius gilberti*, about 3 in head, branched, the branches usually 4; mouth much larger than in *Hypsoblennius*, the maxillary 2¾ to 3 in head, reaching to below posterior margin of eye; teeth even, comb-like; gill opening 2 in head, extending downwards nearly to lower edge of pectoral, much larger than in *Chasmodes saburræ*. Dorsal little notched, the spines slender, 2½ in head, the rays a little higher; anal lower, the rays 3½ to 4 in head; pectorals reaching anal, 1⅓ in head; ventrals 2¼. Dorsal and anal free from caudal.

Color in life, according to Evermann & Jenkins, yellowish; five quadrate spots of darker extending from dorsal to a line drawn from middle of eye to lower base of caudal, the anterior one above tip of pectoral; median line of side with a more or less distinct series of small spots; a short dark vertical line behind the eye; a dark blotch in front of origin of dorsal fin and another on humeral region; under side of head with two ill-defined bands of dark; dorsal fin more or less speckled with black, the anal with a narrow white border above which is a broader band of deep brown.

Six specimens, the largest about 3 inches long, were obtained at Guaymas, Sonora, by Dr. Evermann and Dr. Jenkins in 1887. One of these, No. 412, L. S. Jr. University Mus., examined by us, is the type of the present description.

The large mouth distinguishes this species at once from *Hypsoblennius striatus*, with which it has been identified. The species is intermediate between typical *Chasmodes* and *Hypsoblennius*, and its discovery may make it necessary to merge the latter in *Chasmodes*.

31. **Runula azalea** Jordan & Bollman. Plate xxxvii.

Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 171. Indefatigable Island.

I present a plate taken from one of the types of this interesting little Blenny.

32. **Lucioblennius alepidotus** Gilbert. Plate xxxvii.

Gilbert, Proc. U. S. Nat. Mus., 1890, 103. Gulf of California.

The genus *Lucioblennius* is very close to *Chænopsis* of the West Indies, and belongs to the *Chænopsinæ*. It is not possible to separate this group, as a family, from the *Blenniidæ* until the various intermediate subfamilies, *Pholidichthyinæ*, *Pseudoblenniinæ*, *Emblemariinæ* and *Ophio-*

blenniinæ are better known. The accompanying plate is from one of the types.

Family LYCODAPODIDÆ.

33. **Lycodapus fierasfer** Gilbert. Plate xxxiii.

Lycodapus fierasfer Gilbert, Proc. U. S. Nat. Mus., 1890, 108. Station 2980, etc.

The genus *Lycodapus* cannot be retained among the *Zoarcidæ*, as its general relations are with *Fierasfer* rather than *Lycodes*. It seems to represent a distinct family (*Lycodapodidæ*) distinguished from *Fierasfer* by the normal position of the vent, which is not at the throat. Its gill membranes are separate and free from the isthmus. The accompanying plate is taken from one of the types.

Family BROTULIDÆ.

34. **Bregmaceros macclellandi** (Thompson).

Bregmaceros macclellandi Thompson, Charlesworth's Mag. Nat. Hist., 1840. India.

Bregmaceros bathymaster Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 178. Off Coast of Colombia, near Panama.

Two additional specimens of the species called *Bregmaceros bathymaster* have been found since the species was first described. They are from the same locality, having been mislaid in the removal of the collection. These are in better condition than the first and seem to agree fully with the accounts of *B. macclellandi*.

The genus *Bregmaceros* has the hypercoracoid perforate, as in the *Brotulidæ*. It cannot therefore be placed among the *Gadidæ*, but belongs very near the *Brotulidæ*, if it be not a genuine member of that family.

The remainder of this paper consists of notes by Mr. Frank Cramer on some new or little-known species of *Sebastodes*. This matter is supplementary to Mr. Cramer's recent paper on the Cranial Characters of *Sebastodes*, Proc. Cal. Acad. Sci., 1895, pp. 573 to 611.

Family SCORPÆNIDÆ.

35. **Sebastodes ciliatus** (Tilesius). Plate xl.

Head 3¼, depth 3 to 3¼; D. XIII, 16; A. III, 8; P. 18 to 19. Transverse (oblique) rows of scales 46 to 47 (+3 or 4 on caudal). Pores 46 to 47. Body compressed, deep, its width over the base of the pectorals about 2 in the depth. Dorsal outline descending rapidly backward in a slight curve from origin of first dorsal to end of second dorsal. Depth of peduncle more than 3 in depth of body. Head compressed, profile steep and nearly straight. Eye moderate, orbit circular, 3⅔ in head, a little longer than snout, its posterior rim at about the middle of length of head. Interorbital space strongly convex, its width a little less than orbit, $3\frac{6}{7}$ to 4 in head. Nasal spines small; cranial ridges and spines all obsolete, except the parietal; parietal ridges very slightly developed, with a minute point or none, covered with scales. Mouth moderate, quite oblique; tip of upper jaw on a level with center of eye; maxillary 2⅓ in head, its posterior end reaching about to vertical from posterior edge of pupil. Lower jaw a little projecting, with a slight symphyseal knob. Very narrow bands of teeth on jaws, vomer and palatines. Preorbital moderate, its lower edge scarcely at all indented or entirely continuous, spineless. Suborbital stay scarcely visible. Preopercular spines small, the three upper directed backward and slightly diverging, nearly equidistant and of equal size, the two lower minute or obsolescent. Opercular spines small, without visible ridges. Gill-rakers slender, 2 in orbit, 23 to 24 on anterior limb of first arch. Dorsal fin rather low, the spines delicate, the 5th longest, 2¼ to 2⅙ in head, the 2d about equal to the 11th, the 12th about 1⅓ in the 13th; the membrane rather deeply incised anteriorly, and reaching about half way up the 13th spine. Soft rays about equal to the spines. Caudal fin slightly lunate, its length about 1½ in head. Second and third anal spines about equal in length, the former a little stronger, 1⅓ in the soft rays. Pectorals reaching very nearly to vent, a little less than head, 3½ in body, their base nearly 3 in their length, the median rays longest. Ventrals not reaching vent, about 1⅓ in pectorals. Scales on body, opercles and interorbital space strongly ctenoid; those on mandibles, maxillaries and most of those on cheeks cycloid; preorbital and snout with minute scales. Accessory scales few. Color, in alcohol, dark reddish brown, mottled with lighter; top of head nearly black, a dark stripe on edge of lower jaw, another on maxillary; a dark brown band from preorbital downward and backward to posterior edge of preopercle; a broader band from posterior rim of orbit downward and backward across preopercle and opercle. Fins all dusky, the dorsals somewhat mottled. Peritoneum black. The following description of the color is added from Jordan & Gilbert's Synopsis: "Blackish green, sides rather pale, much mixed with darker; dark shades from eye backward; a black streak on maxillary."

Coast of Alaska, rare; not noticed south of Kodiak when the specimens here described were taken. No other specimens are known, except those of Pallas still preserved in the museum at Berlin.

The above description is taken from three specimens 5¼ to 5¾ inches long, in the possession of the Alaska Commercial Company, one of them since presented to Leland Stanford Jr. University. The following is the synonymy of the species: *Epinephelus ciliatus* Tilesius, Mém. Acad. Sci. St. Petersb., iv, 474, 1810, Aleutian

Islands; *Perca variabilis* Pallas, Zoogr. Rosso-Asiat., iii, 241, 1811, Aleutian Islands, type; red specimens of *Sebastodes introniger* included as the summer coloration; *Sebastodes variabilis* Cuvier & Valenciennes, Hist. Nat. des Poiss., iv, 347; Günther, Cat. Fishes, ii, 99; *Sebastodes ciliatus* Jordan & Gilbert, Synopsis, 658, 1883.

36. **Sebastodes hopkinsi** Cramer. Plate xli.

Sebastodes hopkinsi Cramer, Proc. Cal. Acad. Sci., 1895, 594. Monterey.

Head 3, depth $3\frac{2}{5}$; D. XIII, 14; A. III, 7. Transverse rows of scales (midway between lateral line and base of dorsal fin) about 52; pores about 51. Body compressed, not very deep, profile steep, depth of caudal peduncle a little less than orbit. Head compressed, eye large, orbit $3\frac{1}{2}$ in head. Interorbital space evenly convex, $4\frac{1}{2}$ in head; cranial ridges nearly obsolete; parietal ridges very low but broad, brown. Nasal spines small, far apart; preocular spines rather strong, triangular, supraocular and postocular usually present, very minute, tympanic and parietal spines sometimes present. Mouth moderate, oblique; maxillary very little more than 3 in head, nearly reaching vertical from center of pupil, its posterior end very broad, two in orbit. Lower jaw much projecting, with a prominent, forward directed symphyseal knob, which enters the profile. Narrow bands of teeth on jaws, vomer and palatines. Preorbital rather narrow, its lower margin lobate, with sometimes a small spine. Preopercular spines flat, sharp, nearly equidistant, all directed backward, the 2d longest, 4th and 5th minute. Opercular spines flat, sharp, somewhat diverging, the upper considerably larger; spines on shoulder weak. Gill-rakers 29 on anterior limb of first arch, long, slender, very little more than two in orbit.

Dorsal spines slender, low, the 4th longest, $2\frac{3}{5}$ in head, the 12th ⅔ as long as longest; soft rays equal to longest spines. Only a slight notch between the dorsals. Caudal lunate, 1⅜ in head; second anal spine stronger and considerably longer than third, longer than soft rays, longer than longest dorsal spine, very little more than two in head. Pectorals reaching beyond ventrals but not to vent, a little less than head, 3½ in body; their base narrow, equal to orbit, the lower rays not thickened. Scales rather small, everywhere strongly ctenoid, accessory scales not very numerous; preorbital, snout, maxillaries, mandible and branchiostegal rays scaled; all the fin rays more or less scaly. Color much as in *Sebastodes ovalis*, but with dark blotches and no dark specks. Dark olivaceous, tinged with reddish, especially below; a large, irregular dark blotch under soft dorsal, crossing lateral line; a smaller one on lateral line below posterior part of spinous dorsal; top of head and anterior part of back to about 9th dorsal spine nearly uniformly dark to below lateral line; two indefinite dark bands from behind orbit across preopercle and opercle; lips black. Dorsal fin olivaceous, spinous dorsal dark-edged, soft dorsal darker at base; caudal and pectorals olivaceous, axils dark, ventrals yellowish, anal pale; no small round black spots anywhere. Peritoneum black. Bones of skull thin, cranial ridges nearly obsolete, parietal bones meeting, interorbital space somewhat convex, 3⅓ in base of skull, a slight depression on each side of a sharp, narrow median ridge, and another just within each supraocular ridge; ventral process of basisphenoid rudimentary, mesethmoid processes compressed, not elevated; base of skull very strongly curved. Closely related to *Sebastodes ovalis*. Types 7¾ inches long. No. 2282, L. S. Jr. Univ.

This species is thus far known from Monterey Bay, California, whence the six specimens before us were taken. It is named for Mr. Timothy Hopkins, founder of the Hopkins Seaside Laboratory at Monterey. Since this description was written, numerous additional examples have been secured. It is evidently not rare about Monterey.

37. **Sebastodes eigenmanni** Cramer, n. sp. Plate xlii.

Head $2\frac{7}{10}$; depth $2\frac{5}{6}$. D. VIII, 14; A. III, 8; P. 18 ($\frac{9}{9}$); Lat. 1; pores 41 (+2 on base of caudal); transverse rows of scales 41.

Body compressed, its width (behind opercles) about $2\frac{1}{2}$ in its depth. Greatest width of head $2\frac{2}{5}$ in its length. Profile steep; interorbital space flat, $5\frac{1}{7}$ in head; supraocular and parietal ridges quite well developed, the former flat, the latter diverging backward. Preocular, supraocular, postocular, tympanic and parietal spines present, not very large, but sharp; a curved shallow groove at each side of the interorbital space inside of the supraocular ridges. Orbit large, nearly circular, $3\frac{1}{4}$ in head, its upper rim on a level with the profile. Snout short, about equal to interorbital width; preorbital moderate, with two small sharp spines directed downward and backward; maxillary $2\frac{2}{5}$ in head, reaching a little beyond vertical from posterior edge of pupil; mandible projecting somewhat, with a moderate symphyseal knob. The uppermost preopercular spine small, directed a little upward, the second longest, horizontal, the fourth and fifth small, but evident; upper opercular spine slender and sharp, the lower shorter. Gill-rakers long and slender, about $2\frac{1}{3}$ in the orbit, 23 on horizontal limb of first arch. Scales rough, ctenoid, those on opercles, cheeks and interorbital space and snout somewhat rough; those on maxillary, mandible and breast mostly cycloid; very few accessory scales. Spines of first dorsal moderate, the fourth longest, 2¼ in head, the fifth, sixth and seventh nearly equal, the twelfth 2¼ in the fourth; the membrane deeply incised; longest dorsal ray about equal to longest spine. Anal spines graduated; the second nearly as long as and but little stronger than third, 2⅗ in head, 1⅓ in the soft rays. Caudal truncate, or a little rounded (the rays somewhat injured). Base of pectorals 4 in head, the nine lower rays simple, the middle rays longest, reaching a little beyond vent, 3⅕ in length of body. Ventrals reaching vent.

Color in alcohol: Reddish-brown; pale below; dorsals and pectorals dusky; membranes of spinous dorsal black-edged, and tips of ventrals blackish. Peritoneum white, with a few black specks.

One specimen, 7 inches long, taken at Monterey, California, by Dr. Wilbur W. Thoburn; No. 4046, L. S. Jr. Univ. Mus.

It is named for Dr. Carl H. Eigenmann, of the University of Indiana, in recognition of his work on the genus *Sebastodes*. The species is nearest to *Sebastodes ovalis*, but the mouth is larger and the color different.

38. **Sebastodes darwini** Cramer, n. sp.

?*Sebastes oculata* Jenyns, Voyage H. M. S. Beagle, Zool. Fish. No. ii, part iv, 37, 1840, Valparaiso.

Closely allied to *Sebastodes rosaceus*. Spines similar in number, but a trifle higher; upper spines on preopercle longest. Gill-rakers slender, x+18, nearly as long as pupil. Jaws subequal. Pectoral short, 1⅓ in head, the lower rays thickened; second anal spine long, curved. A. III, 6. Compared with a specimen of *S. rosaceus* of the same size, the snout is blunter in *S. darwini*, the cranial ridges are a shade higher; the pectoral is shorter, reaching only to vent (while in *S. rosaceus* it reaches to second anal spine; second anal spine much longer than third (subequal in *S. rosaceus*); dorsal spines lower, 3 in head ($2\frac{2}{3}$ in *rosaceus*). Scales similar. Mexillones, Peru.

Here described from MS. notes of Dr. D. S. Jordan, taken from the type in Mus. Comp. Zool., Cambridge, Mass.

Jenyns described a specimen from Valparaiso as the *Sebastodes oculatus* of Cuvier and Valenciennes; but pointed out distinctions between the two, which with later knowledge of related species prove beyond a doubt that it is distinct. This specimen probably belongs to *Sebastodes darwini.* Jenyns also mentions a figure of another species from Valparaiso, very distinct from the others in having the spines of the head less developed. More than 50 species of the genus have been described from the north temperate waters of the Pacific Coast of America, and it is not improbable that the species of this genus will be found numerous in the temperate waters of the South American Coast.

39. **Sebastodes gilberti** Cramer, n. sp. Plate xliii.

Head $2\frac{1}{10}$; depth $2\frac{3}{4}$ to 3. D. XIII, 13. A. III, 6. P. 17; transverse (oblique) rows of scales 40 to 42; lat. l. (pores) about 39 to 42. Body somewhat compressed, its width over the base of the pectorals nearly two in the depth. Head compressed, profile steep, nearly straight. Preocular, postocular, tympanic and parietal spines and ridges present, all rather delicate, these spines somewhat appressed, the parietal ridges diverging backward in slight curves. Interorbital space $1\frac{1}{2}$ in orbit, a little concave, with a pair of low ridges and a shallow median groove between them. Orbit high up, nearly circular, 4 in head, its posterior rim at about the middle of length of head. Preorbital scarcely lobate on its ventral margin, usually with one short triangular spine posteriorly. Suborbital stay not visible externally. Preopercular spines all directed backward, the two uppermost closer together, the two lowermost weak. Opercular spines rather small, sharp, without visible ridges. Mouth nearly horizontal, the tip of the upper jaw nearly on a level with the lower rim of the orbit. Maxillary $2\frac{2}{7}$ in head, its posterior end reaching about to vertical from posterior rim of orbit. Lower jaw very slightly projecting, with a slight symphyseal knob. Teeth on jaws, vomer and palatines, the bands on the latter narrow. Gill-rakers rather slender, 2 to 3 in orbit, 23 on anterior limb of first arch.

Fourth dorsal spine highest, $1\frac{1}{13}$ in head; membrane of first dorsal very deeply incised, reaching only ¼ of the way up on the anterior side of the 3d, and about ⅓ of the way up on the 4th spine, nearly to the tip of the 12th, and about half way up on the 13th spine; soft rays lower than the spines, about 1⅓ in the longest spine. Caudal fin truncate, with 11 to 12 full length rays, about $1\frac{3}{5}$ in head. Second anal spine longer and much stronger than third, $2\frac{2}{5}$ in head, $1\frac{1}{5}$ in the soft rays. Pectoral fin reaching to or a little beyond vent, 3¼ in length of body, the median rays longest, the 8 lower rays unbranched and thickened; base of fin 3 in its length. Ventrals reaching not quite to vent, the spine about equal to the 3d anal spine.

Scales rather small, those of body, cheeks and interorbital space all ctenoid, those on breast cycloid; maxillary with minute scales, lower jaw and top of snout naked. Accessory scales few, some of them ctenoid.

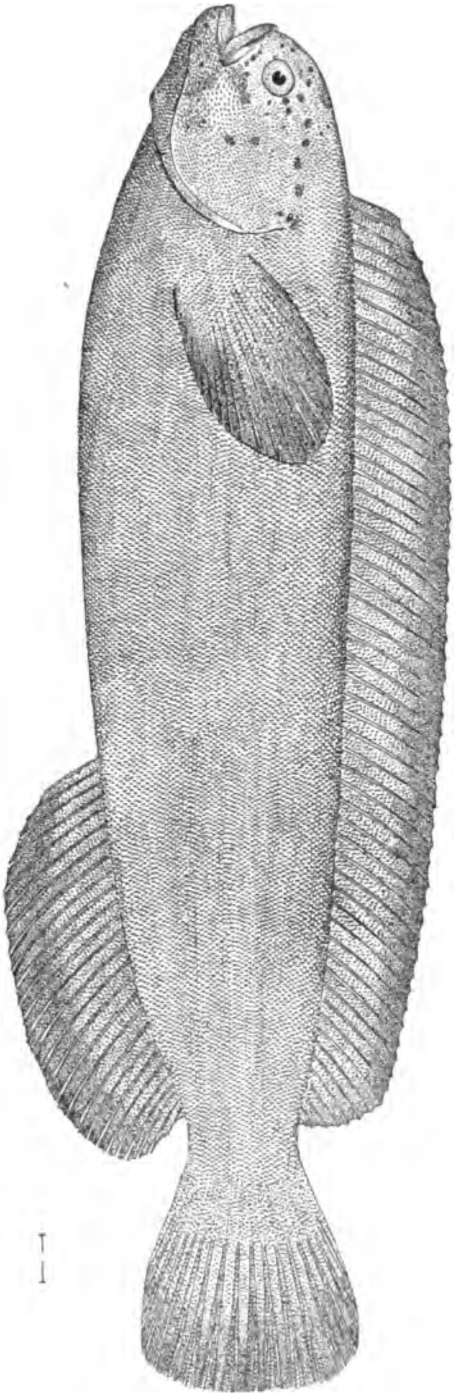
Color: Head blackish above, lips dusky, a dark band from front of orbit forward along side of snout; a dark stripe on maxillary; a blackish or olivaceous band from preorbital backward and downward across preopercle; another broader band from posterior rim of orbit across preopercle and lower end of subopercle; a dark blotch on opercle; a blackish area in front of dorsal and under first and second spines, extending with interruptions to axils of pectorals and on to the base of the fin, and downward and backward in a narrow broken band toward vent; another band from below 6th and 7th dorsal spines downward and backward nearly to origin of anal; a third short one from below 9th and 10th spines to lateral line; a broad one under soft dorsal extending below lateral line, and another across peduncle; all these dark areas extend up on the dorsal fin; their outlines are not sharply defined, and they as well as the lighter areas of the body are mottled with scattered, much darker spots; the lighter areas were in the fresh state a dull brick red, becoming lighter below. Dorsal membrane blackish between 1st and 3d, and between 5th and 11th spines. Soft dorsal spotted with blackish anteriorly; membrane of caudal dusky, the dark much broken into spots; anal and ventrals dusky. Pectorals with a broad, transverse, dark, spotted band near base, and a transverse dusky area with darker spots on distal half. Fins in life more or less tinged with the reddish color. Peritoneum white. Types, three specimens 7½, 8¼ and 8½ inches long (No. 3893, L. S. Jr. Univ.), from Monterey, found in San Francisco market. Many others have been since obtained from Monterey, where it is common. The species is an ally of *Sebastodes carnatus* and *Sebastodes chrysomelas*. It had been previously confounded with the young of *Sebastodes carnatus*. It seems to reach a smaller size than any of the related forms.

This species is named from Prof. Charles Henry Gilbert, of Leland Stanford Junior University.

LIST OF PLATES.

XX. Zaprora silenus: type. Nanaimo, British Columbia.
XXI. Nemichthys avocetta. Victoria, British Columbia.
Avocettina gillii. Albatross Station, off Oregon.
XXII. Salmo gairdneri crescentis: type. Lake Crescent, Washington.
XXIII. Salmo gairdneri beardsleei: type. Lake Crescent, Washington.
XXIV. Xenocys jessiæ: type. Charles Island, Galapagos.
XXV. Umbrina sinaloæ: type. Mazatlan, Mexico.
XXVI. Emmydrichthys vulcanus: type. Hawaiian Islands.
XXVII. Cottus annæ: type. Eagle River, Gypsum, Colorado.
XXVIII. Tarandichthys filamentosus: type. Off Santa Barbara Islands.
XXIX. Icelinus quadriseriatus. Coast of California.
XXX. Ulca marmorata. Unalaska.
XXXI. Kathetostoma averruncus: type. Off Panama.
XXXII. Gillellus semicinctus: type. Gulf of California.
Rimicola eigenmanni: type. Todos Santos Bay, Baja California.
XXXIII. Dactylagnus mundus. Gulf of California.
Lycodapus fierasfer: type. Albatross Station, 2980, N. W. Coast of Mexico.
XXXIV. Bryssetæres pinniger: type. Puerto Refugio, Gulf of California.
XXXV. Arbaciosa humeralis: type. Puerto Refugio, Gulf of California.
XXXVI. Arbaciosa rhessodon. San Diego, California.
XXXVII. Arbaciosa eos. Mazatlan, Mexico.
Runula azalea: type. Indefatigable Island.
Lucioblennius alepidotus: type. Gulf of California.
XXXVIII. Thalassophryne dowi. Panama.
XXXIX. Chasmodes jenkinsi: type. Guaymas, Mexico.
XL. Sebastodes ciliatus. Kodiak Island, Alaska.
XLI. Sebastodes hopkinsi: type. Monterey, California.
XLII. Sebastodes eigenmanni: type. Monterey, California.
XLIII. Sebastodes gilberti: type. Monterey, California.

PLATE XX.

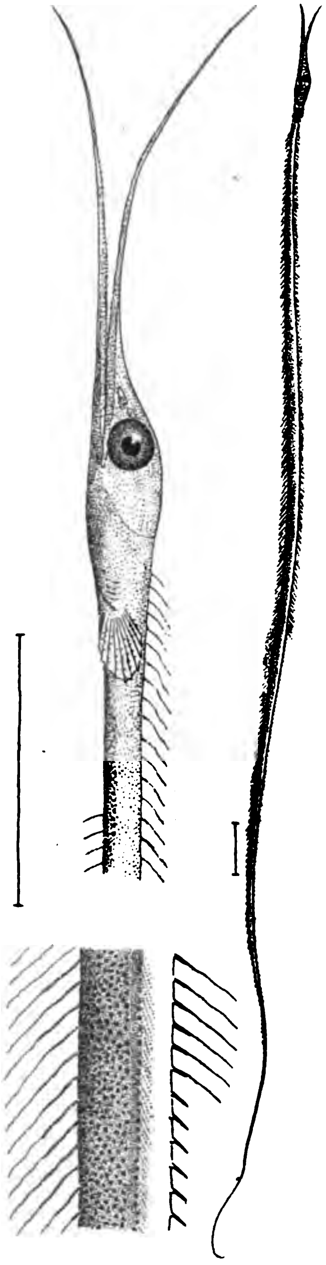


ZAPRORA SILENUS

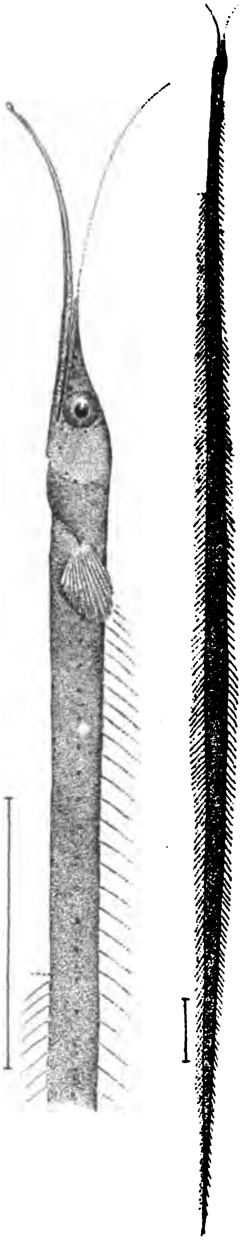
Anna L. Brown, Del.

Lith. Britton & Rey S.F.

PLATE XXI.



NEMICHTHYS AVOCETTA

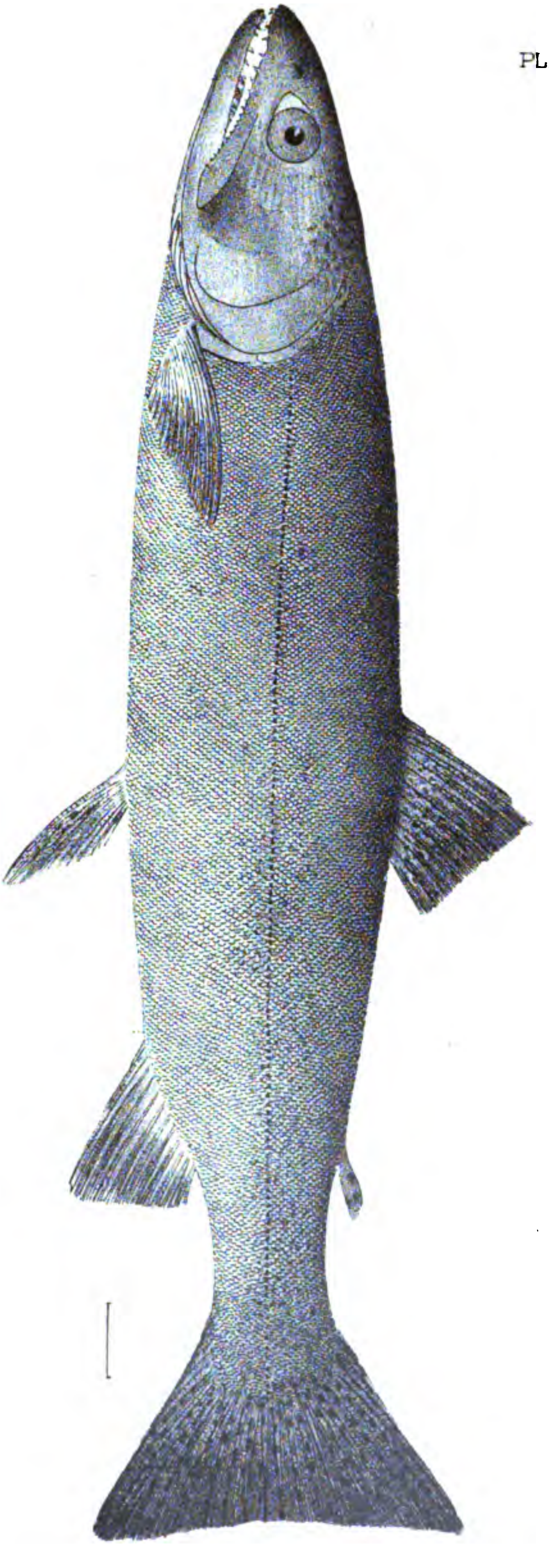


AVOCETTINA GILLII

Anna L. Brown Del.

Lith. Britton & Rey S.F.

PLATE XXII.

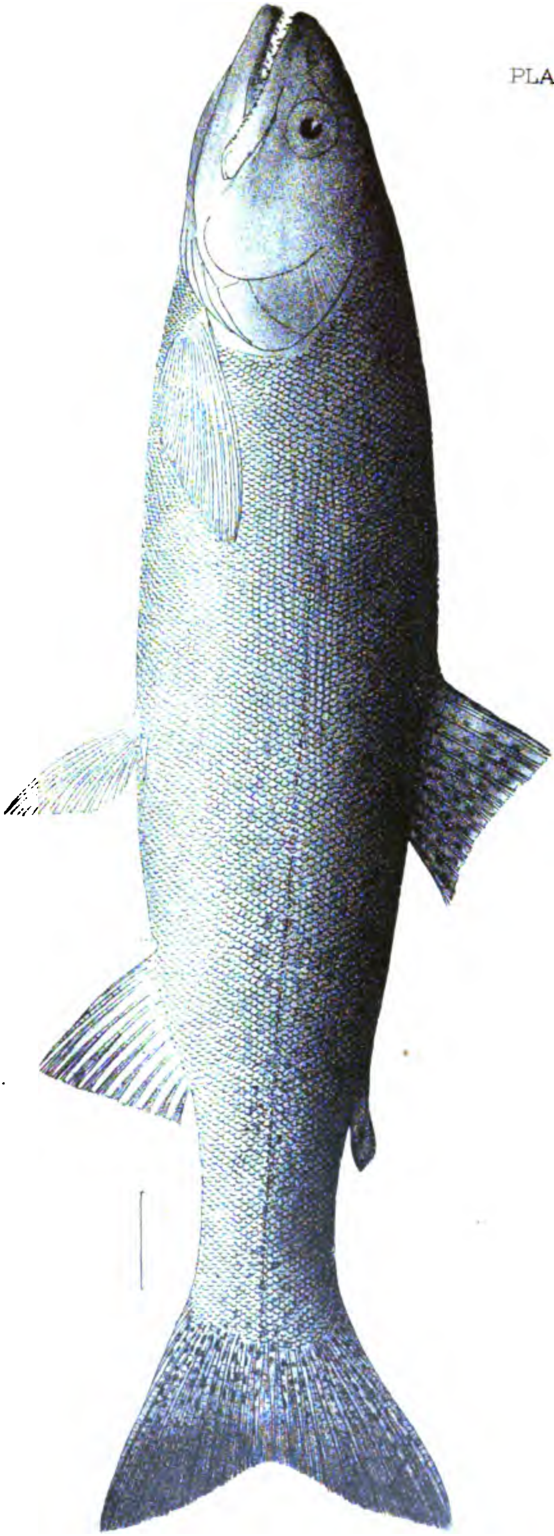


Anna L. Brown, Del.

SALMO GAIRDNERI CRESCENTIS

Lith. Britton & Rey, S.F.

PLATE XXIII.

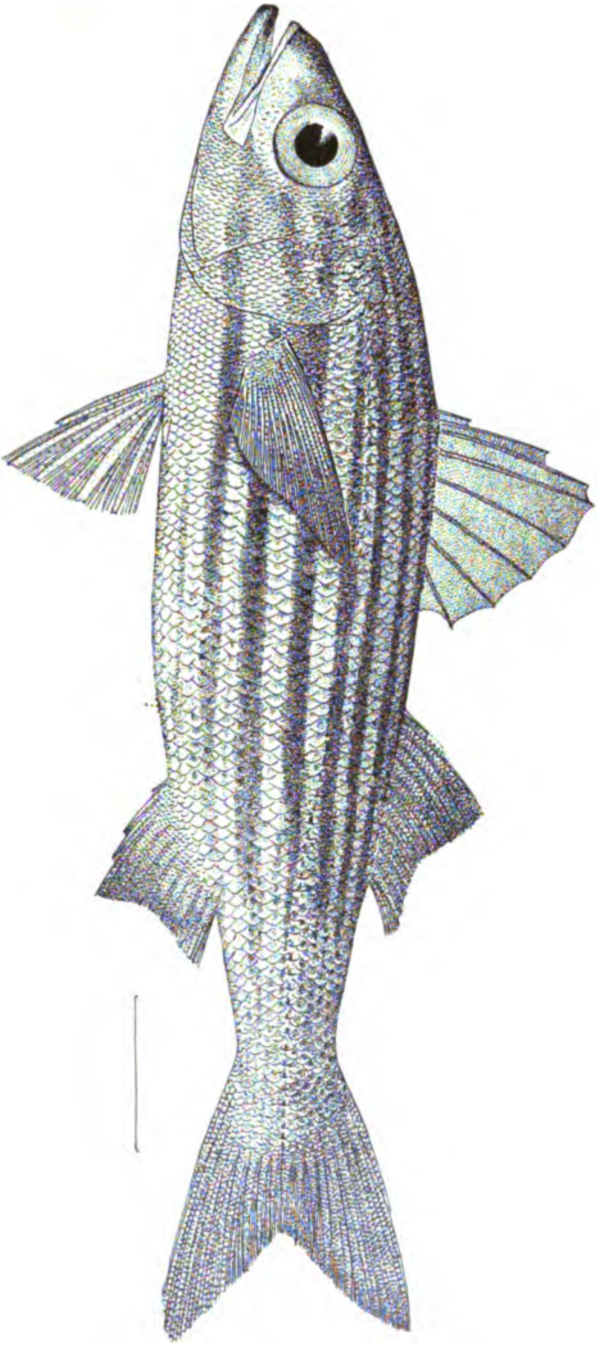


Anna L. Brown Del.

SALMO GAIRDNERI BEARDSLEEI

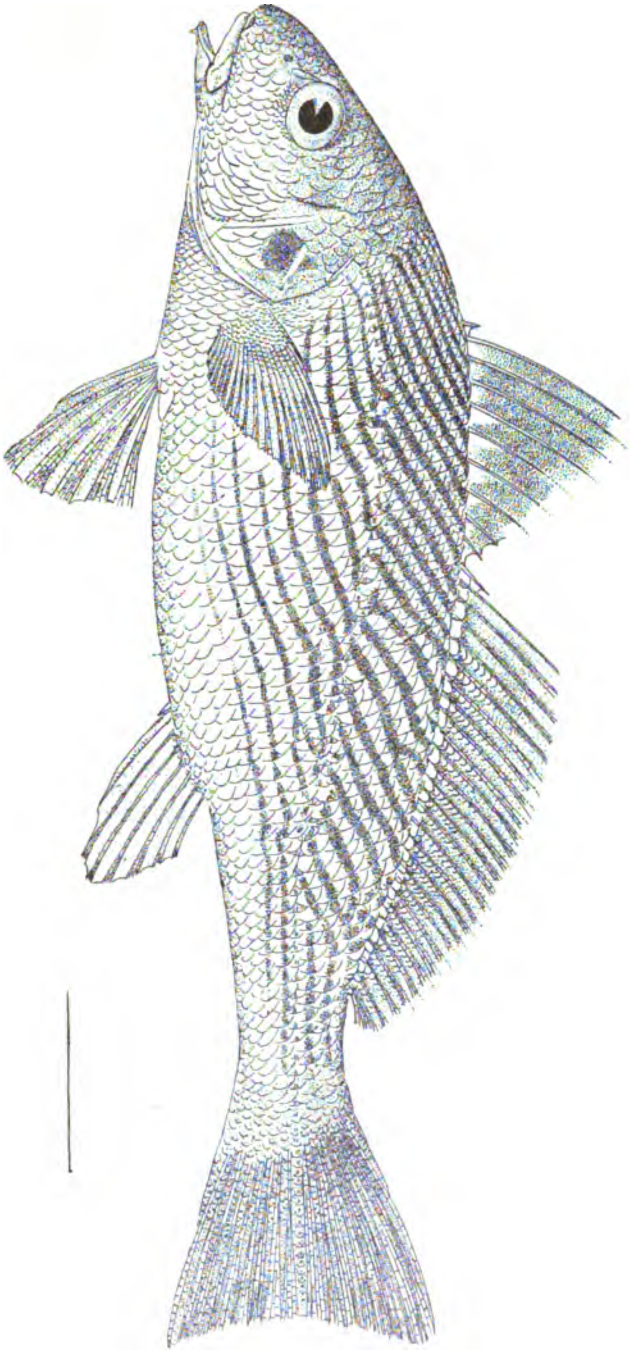
Lith. Britton & Rey. S.F.

PLATE XXIV.



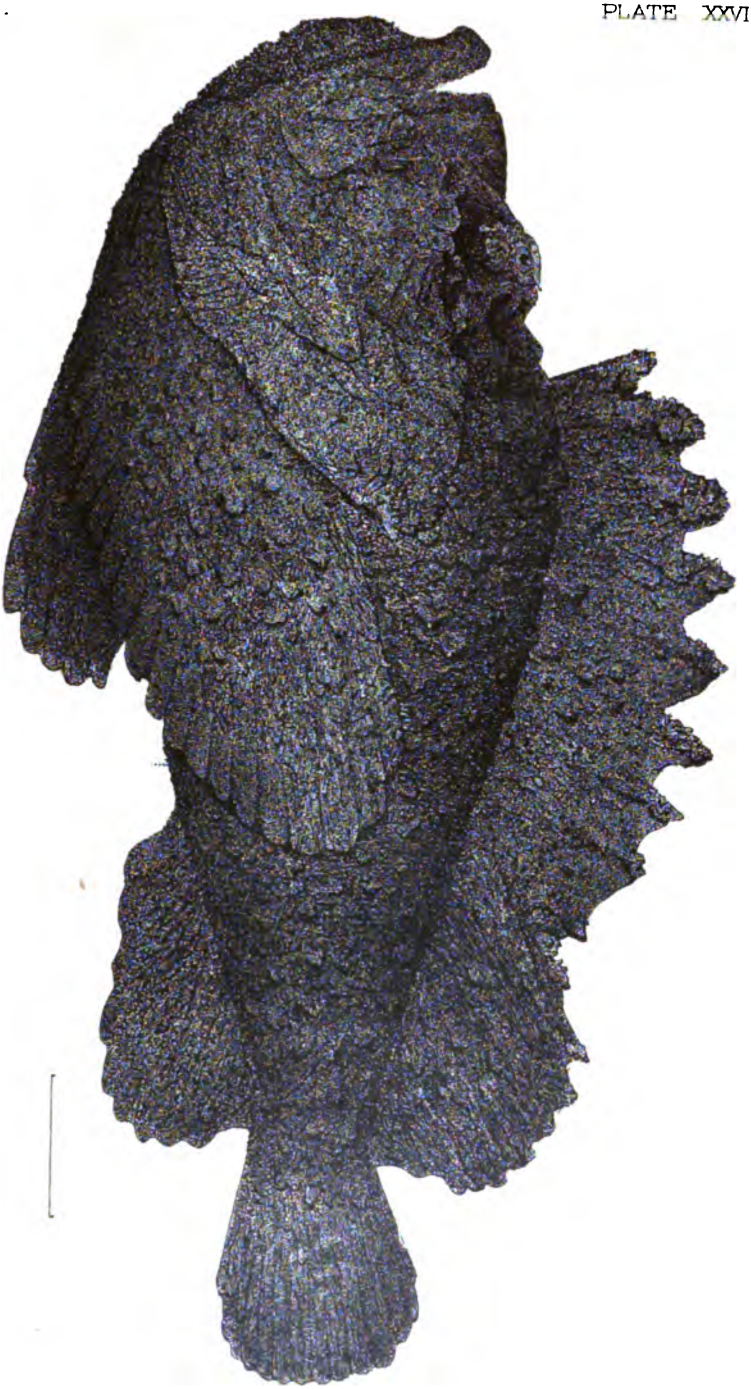
XENOCYS JESSIÆ

Anna L. Brown Del. Lith. Britton & Rey S.F.



UMBRINA SINALOÆ

Anna L. Brown, Del. [illegible]

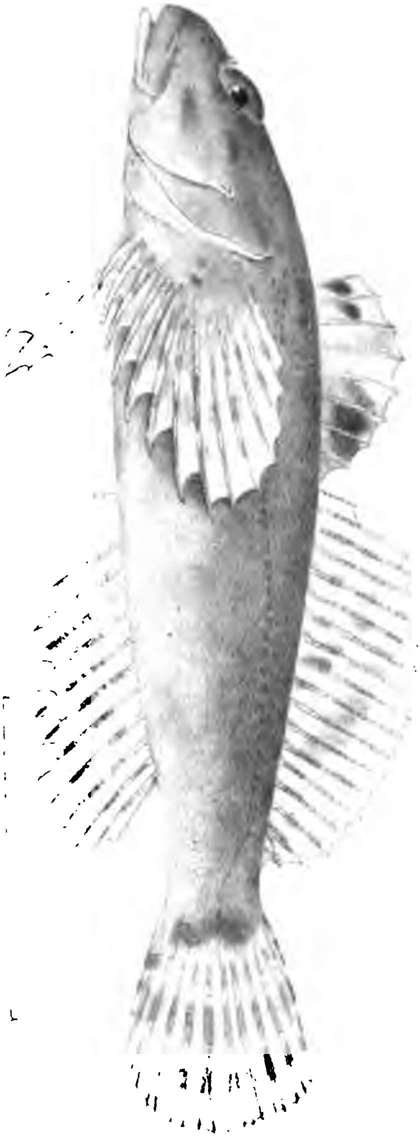


EMMYDRICHTHYS VULCANUS

[illegible] Del.

LITH. [illegible]

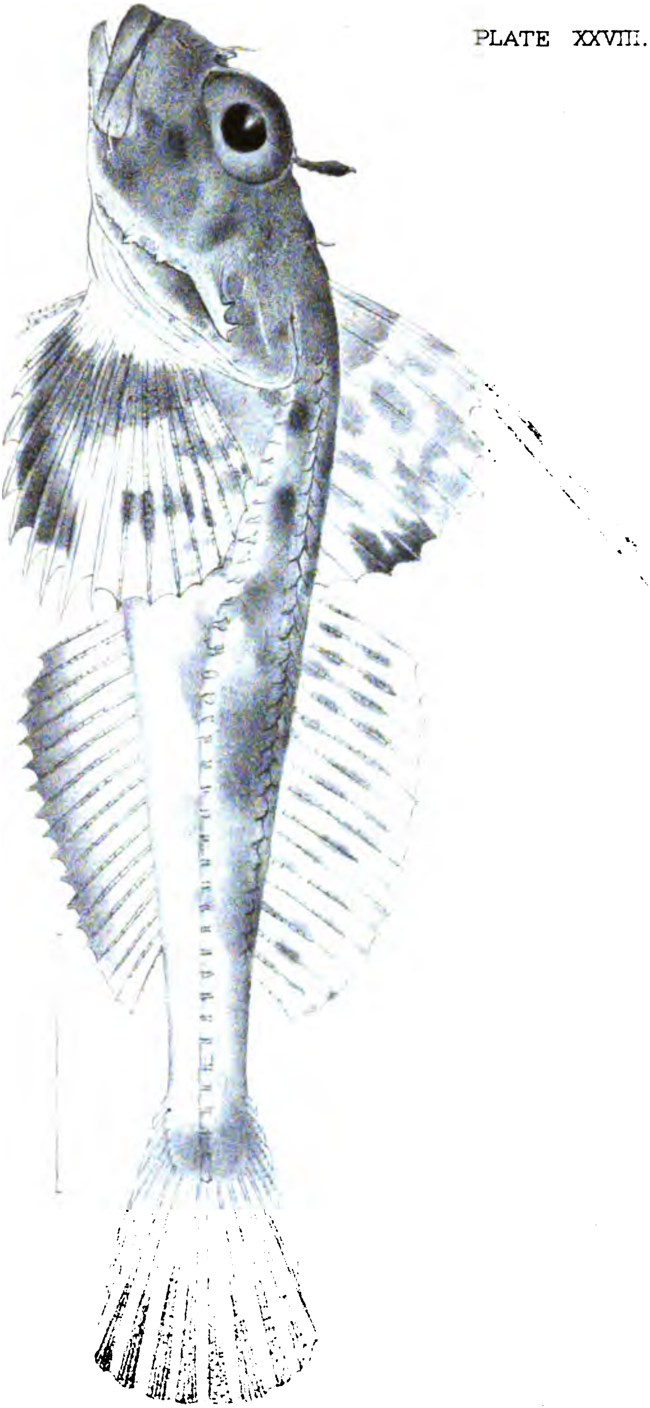
PLATE XXVII.



COTTUS ANNÆ

ANNA L. BROWN, DEL.

LITH. BRITTON & REY S.F.

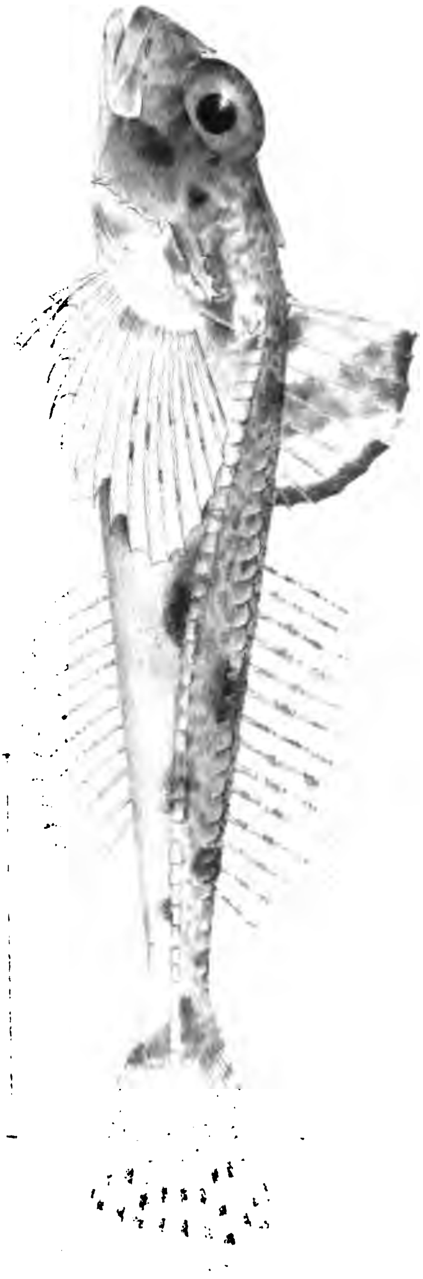


TARANDICHTHYS FILAMENTOSUS

ANNA L. BROWN, DEL.

LITH. BRITTON & REY. S.F.

PLATE XXIX.

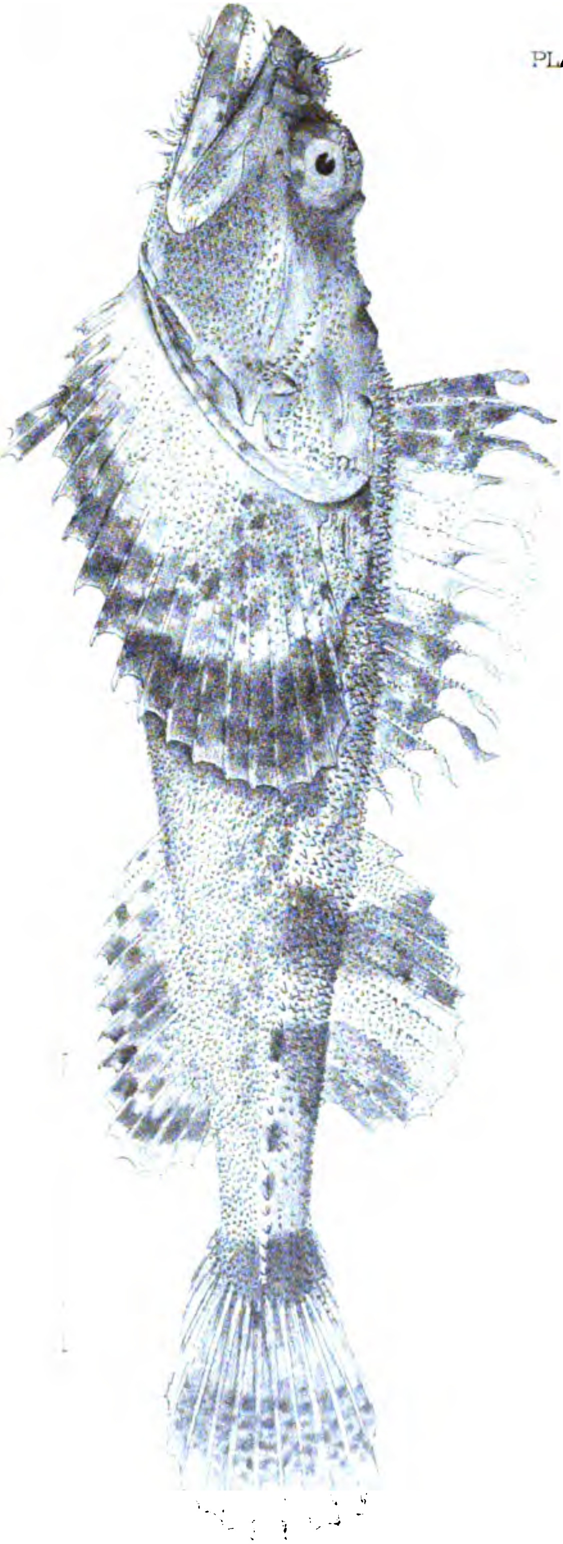


ICELINUS QUADRISERIATUS

Anna L. Brown Del.

Lith. Britton & Rey S.F.

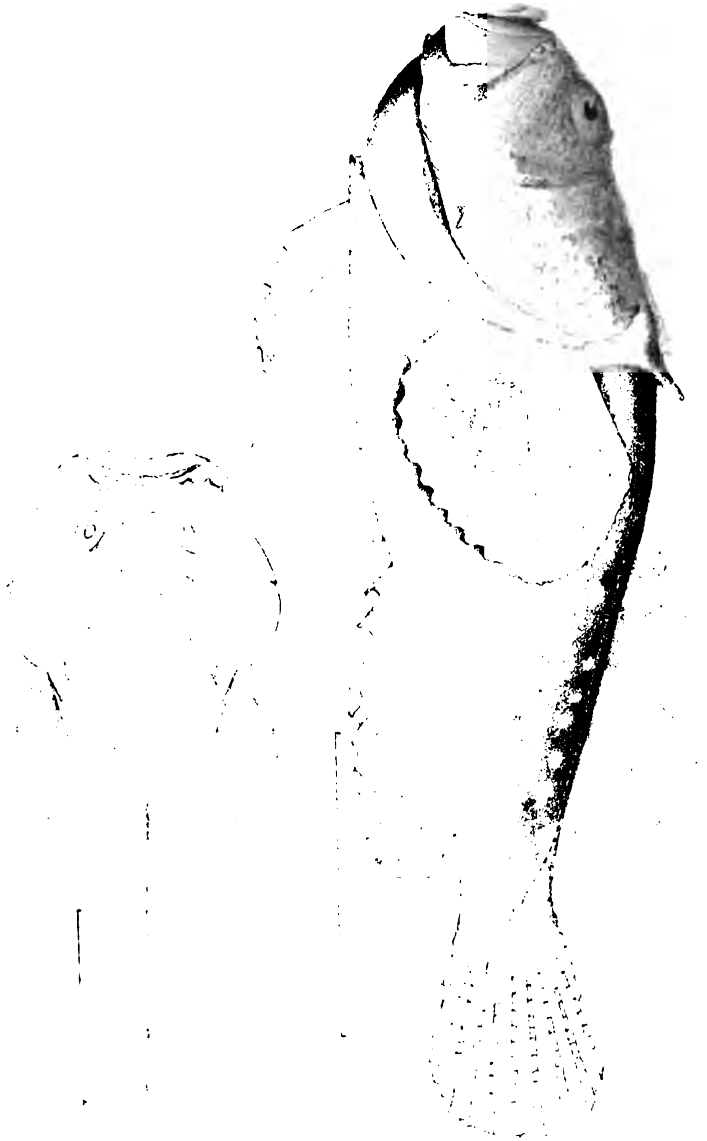
PLATE XXX.



ULCA MARMORATA

Anna L. Brown Del.

Lith. Britton & Rey. S.F.

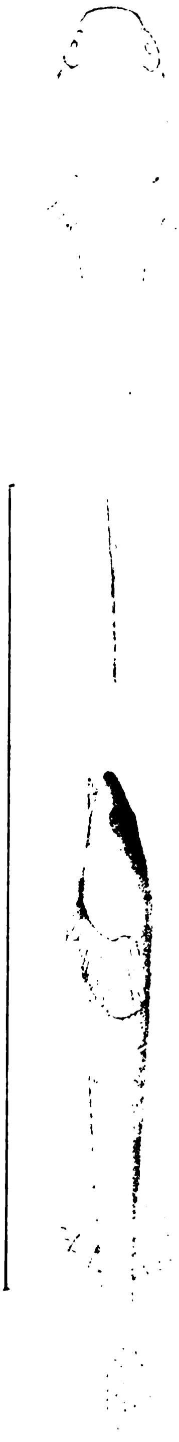


KATHETOSTOMA AVERRUNCUS

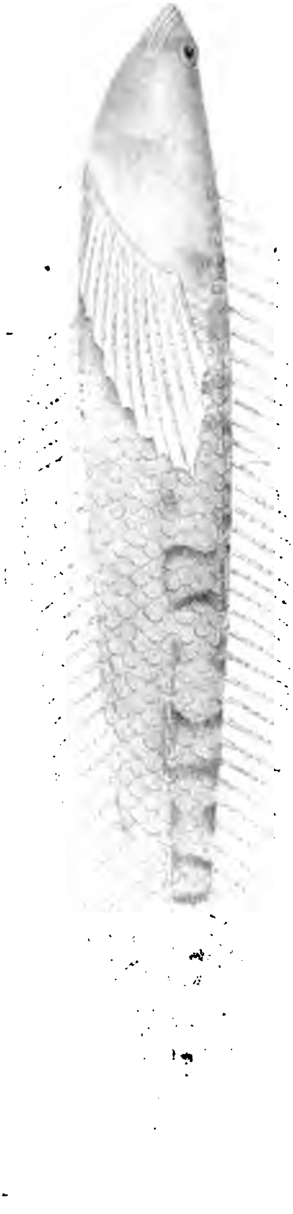
Anna L. Brown, Del.

Lith. Britton & Rey, S.F.

PLATE XXXII.



RIMICOLA EIGENMANNI

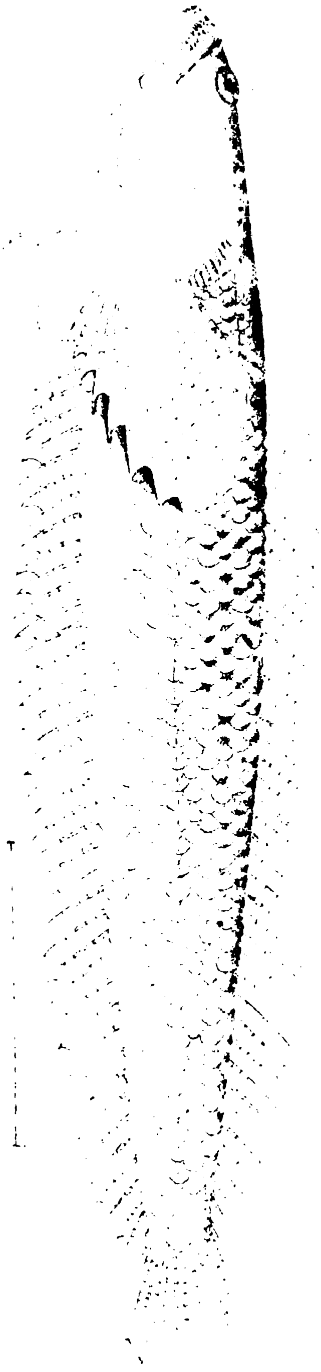


GILLELLUS SEMICINCTUS

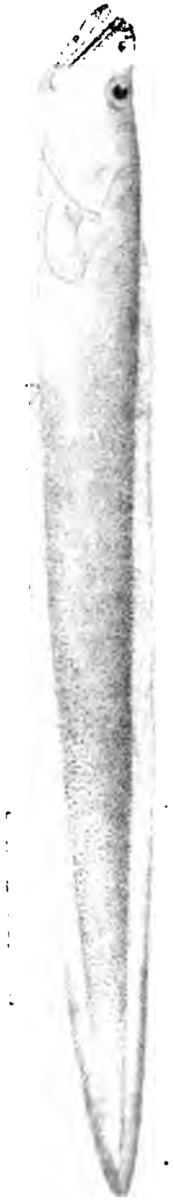
Anna L. Brown Del.

[illegible]

PLATE XXXIII.



DACTYLAGNUS MUNDUS

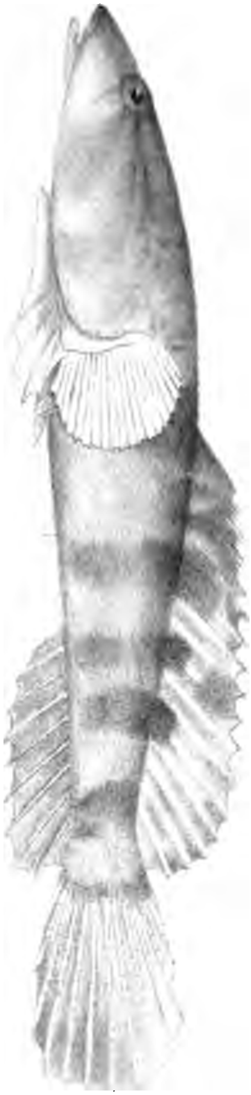


LYCODAPUS FIERASFER

Anna L. Brown, Del.

Lith. Britton & Rey, S.F.

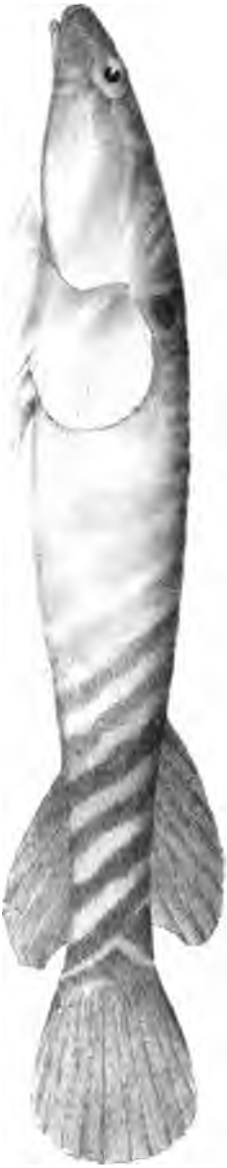
PLATE XXXIV.



BRYSSETÆRES PINNIGER

[illegible] Brown Del. Lith. Britton & Rey S.F.

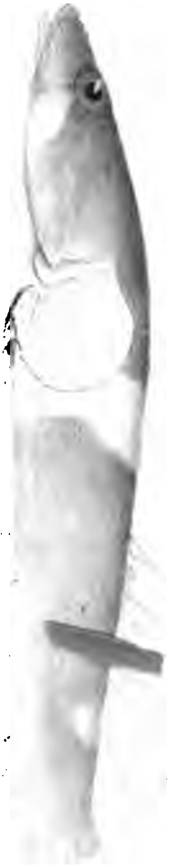
PLATE XXXV.



ARBACIOSA HUMERALIS

Anna L. Brown, Del.

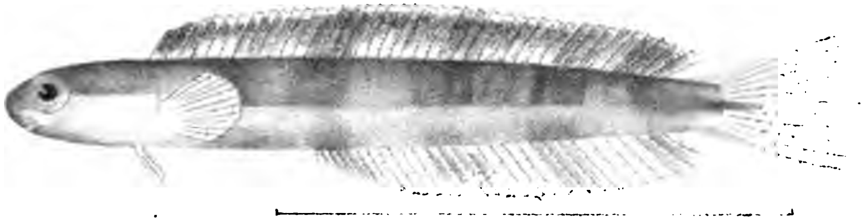
Lith. Britton & Rey, S.F.



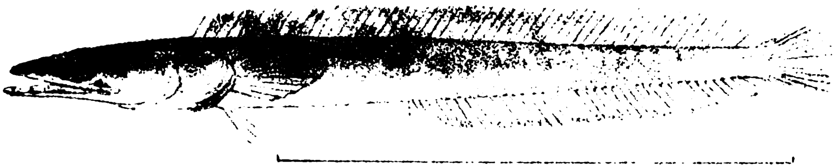
ARBACIOSA RHESSODON

Anna L. Brown Del. LITH. BRITTON & REY S.F.

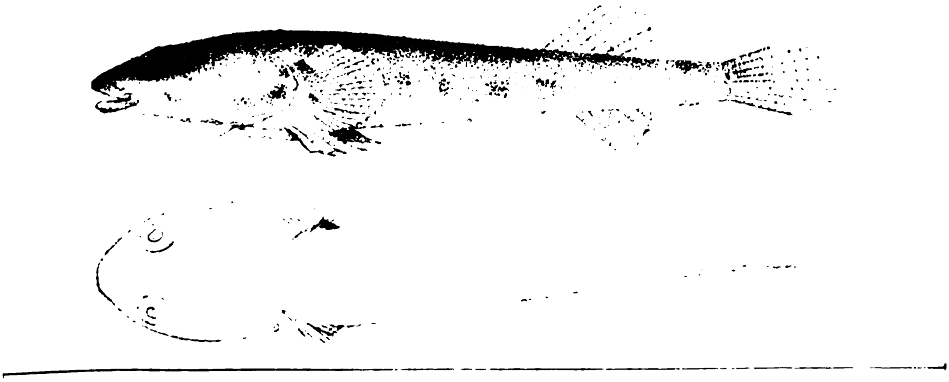
PLATE XXXVII.



RUNULA AZALEA



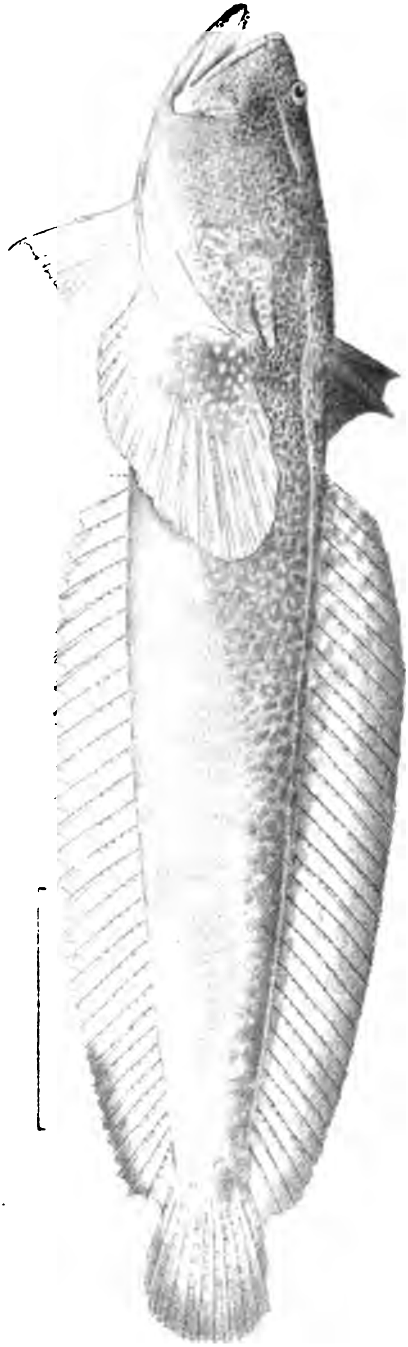
LUCIOBLENNIUS ALEPIDOTUS



ARBACIOSA EOS

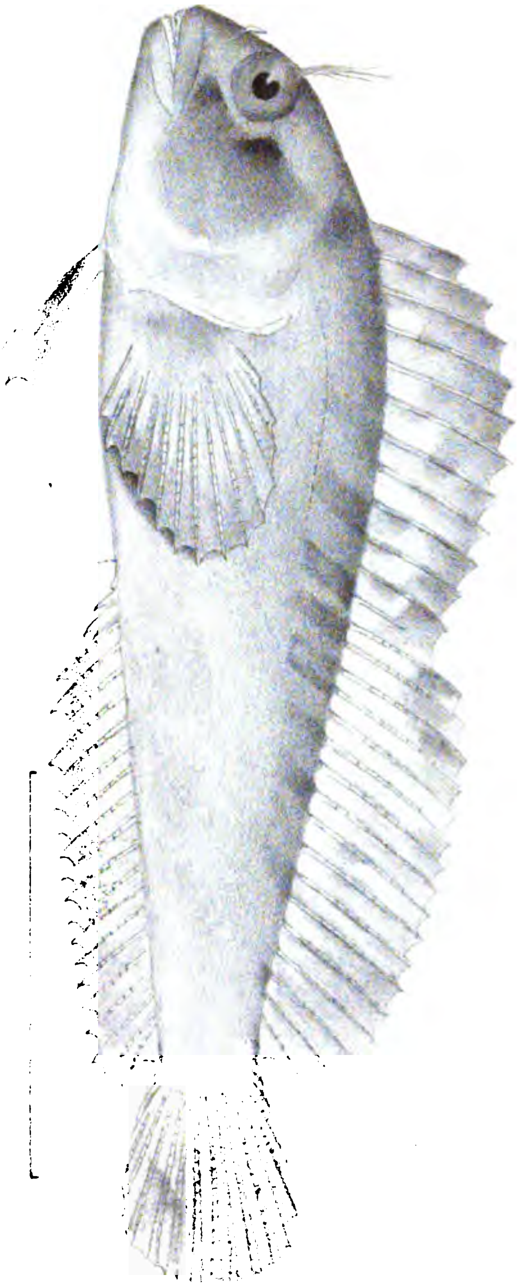
Anna L. Brown Del.

LITH [illegible]



THALASSOPHRYNE DOWI

Anna L. [illegible] Del. [illegible]

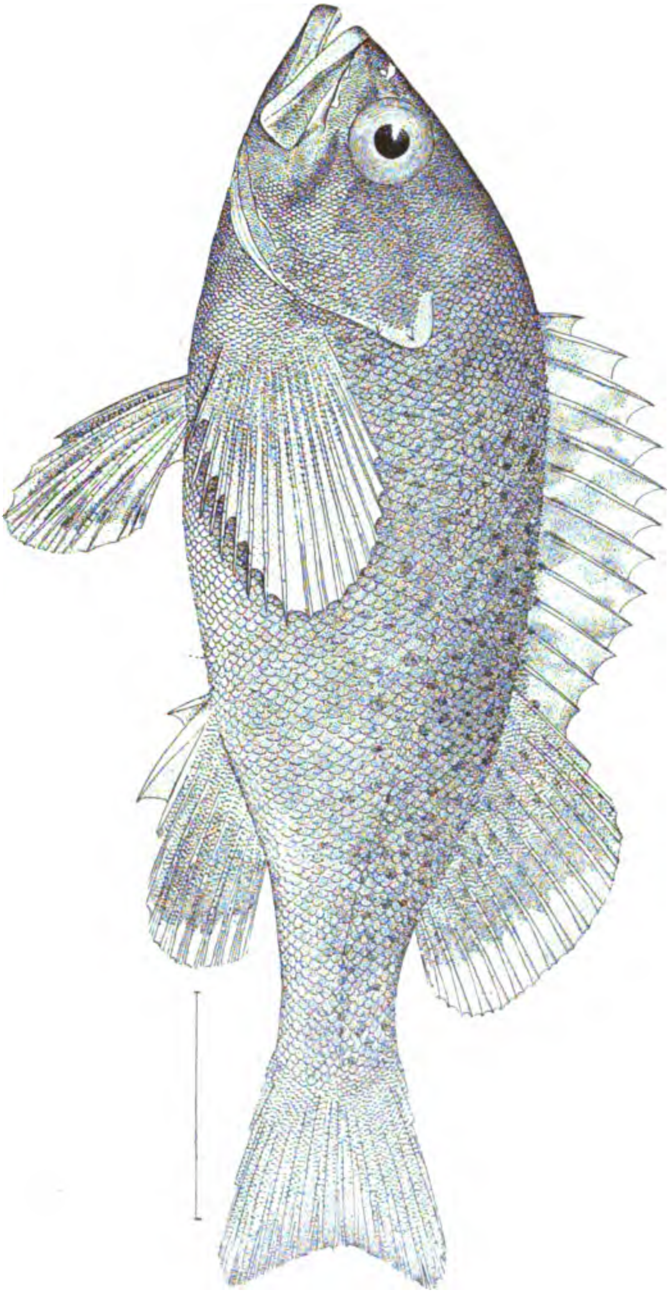


CHASMODES JENKINSI

Anna L. Brown Del.

Lith. Britton & Rey, S.F.

PLATE XL.

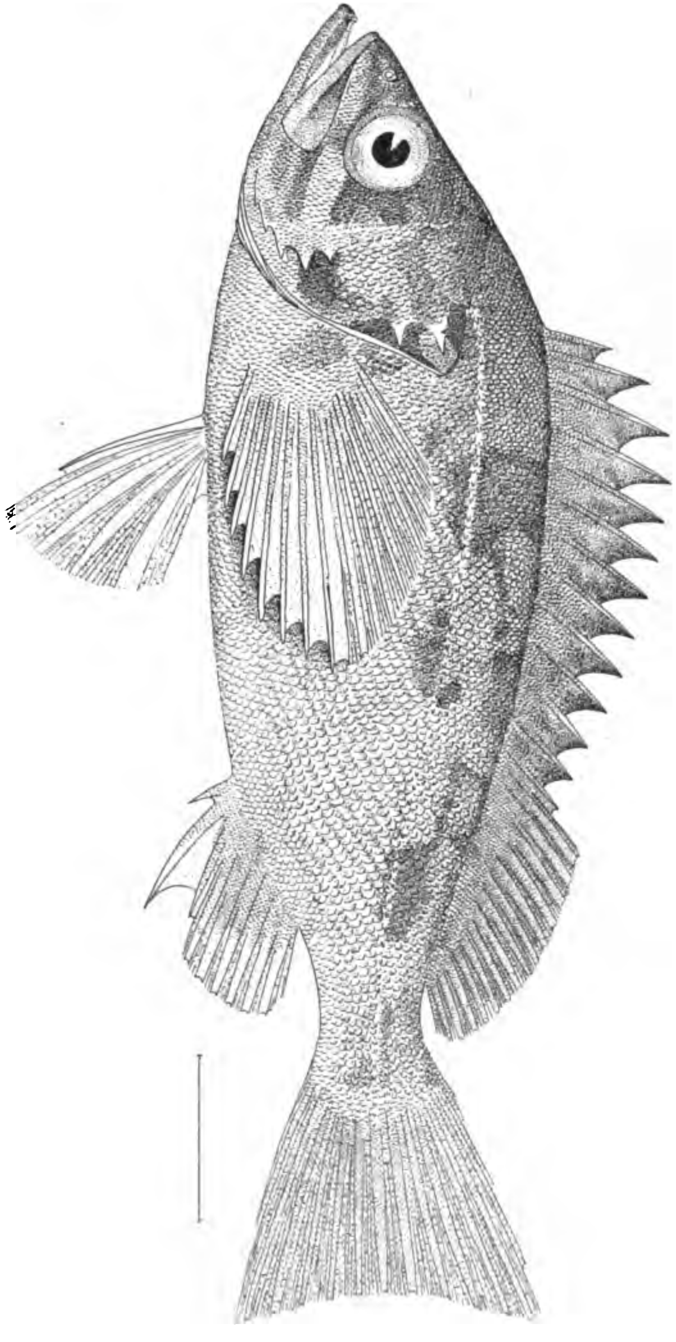


SEBASTODES CILIATUS

Anna L. Brown Del.

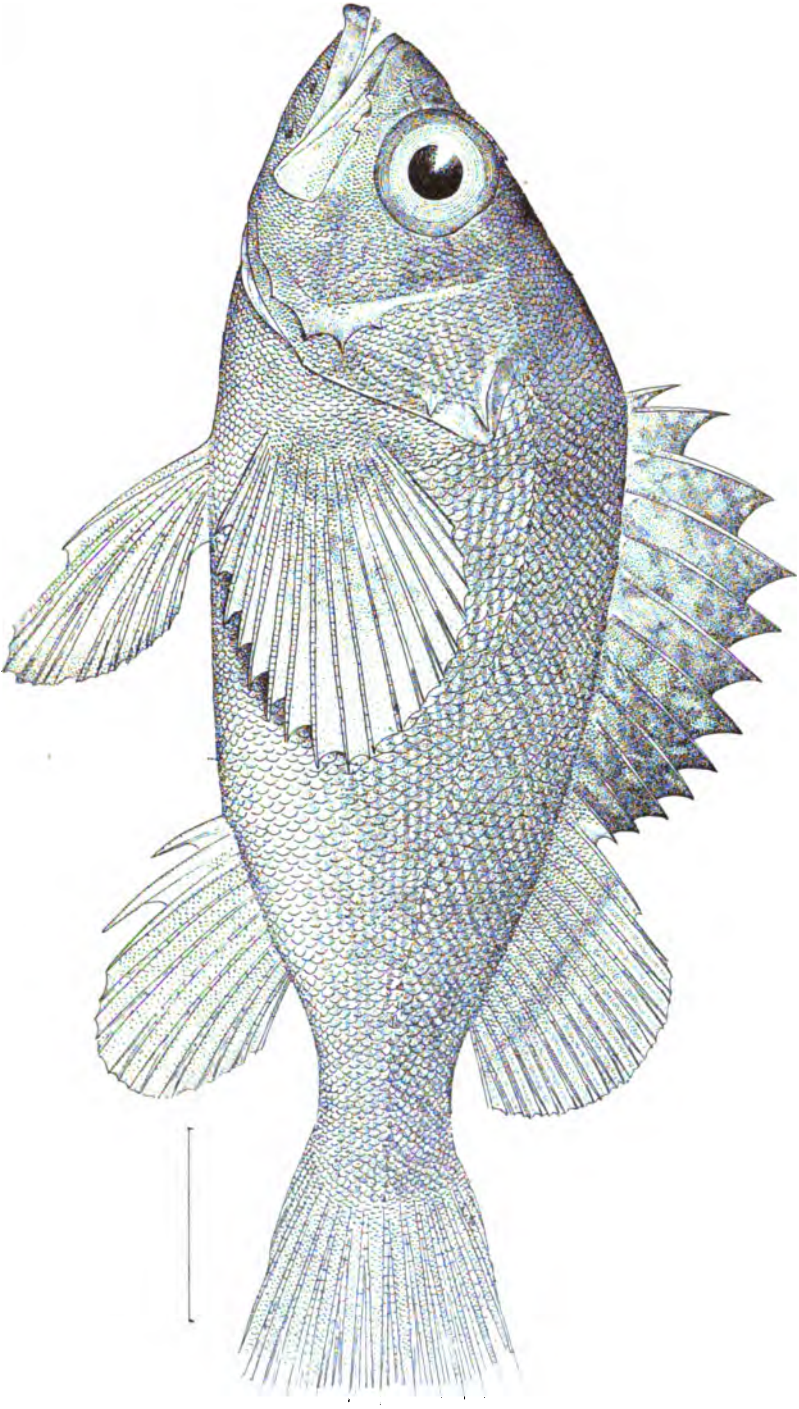
Lith. Britton & Rey, S.F.

PLATE XLI.



SEBASTODES HOPKINSI

Anna L. Brown Del. Lith. Britton & Rey, S.F.

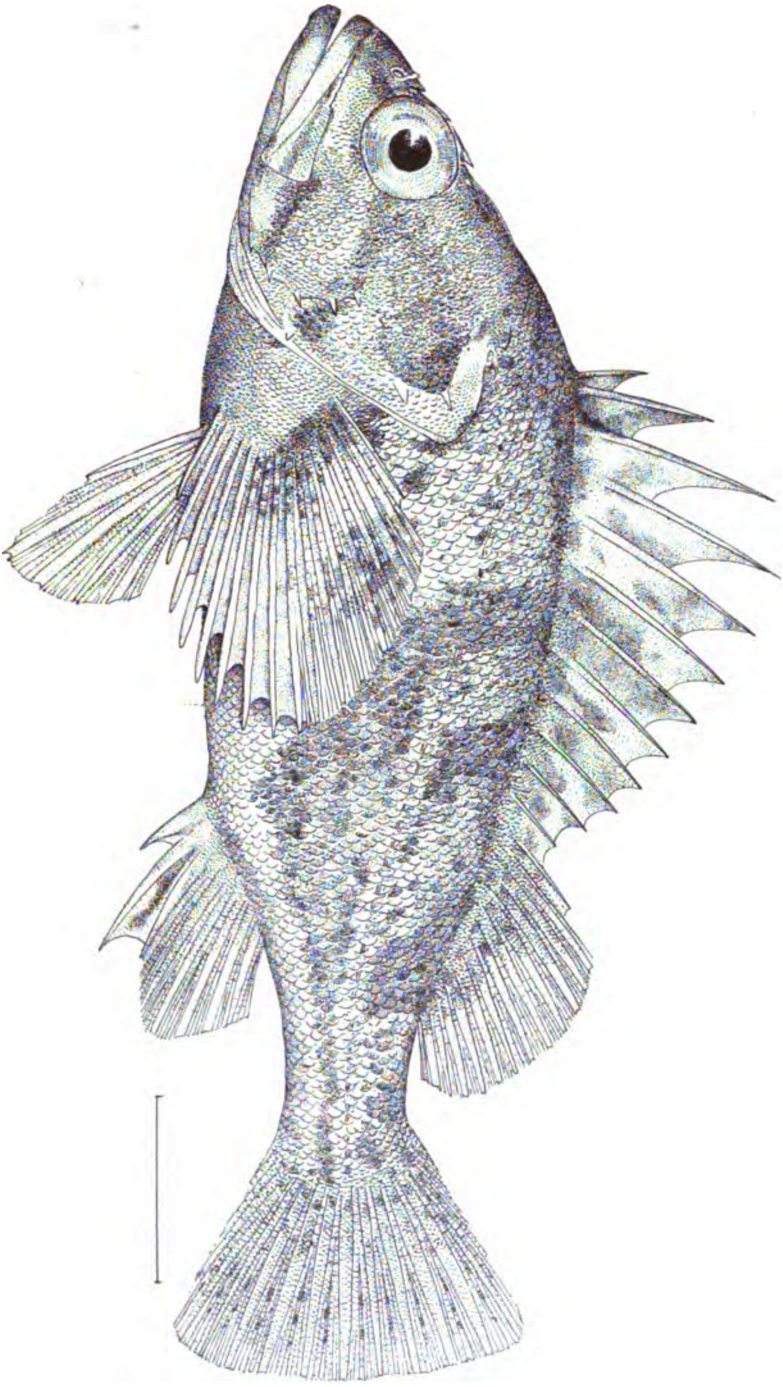


SEBASTODES EIGENMANNI

Anna L. Brown Del.

Lith. Britton & Rey. S.F.

PLATE XLIII.



SEBASTODES GILBERTI

Anna L. Brown, Del.

[illegible]

LELAND STANFORD JUNIOR UNIVERSITY PUBLICATIONS

CONTRIBUTIONS TO BIOLOGY

FROM

THE HOPKINS SEASIDE LABORATORY.

VI

NOTES ON FRESH WATER FISHES

OF THE PACIFIC SLOPE OF NORTH AMERICA.

BY

CLOUDSLEY RUTTER.

Leland Stanford Jr. University,
Palo Alto, California,
1896.

LELAND STANFORD JUNIOR UNIVERSITY PUBLICATIONS

CONTRIBUTIONS TO BIOLOGY

FROM

THE HOPKINS SEASIDE LABORATORY.

VI

NOTES ON FRESH WATER FISHES

OF THE PACIFIC SLOPE OF NORTH AMERICA.

BY

CLOUDSLEY RUTTER.

(Reprint from the Proceedings of the California Academy of Sciences, Series 2, Vol. VI.)

LELAND STANFORD JR. UNIVERSITY,
PALO ALTO, CALIFORNIA,
1896.

PREFATORY NOTE.

This memoir is the sixth of a series designed to illustrate the investigations and explorations of the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. The series is issued under the patronage of Timothy Hopkins, Esq., of Menlo Park, California. The present paper is published with the co-operation of the California Academy of Sciences, appearing simultaneously in its present form and as part of the Proceedings of the Academy.

CHARLES H. GILBERT,
OLIVER P. JENKINS,
Editors.

Date of publication, June 29, 1896.

NOTES ON FRESH WATER FISHES OF THE PACIFIC SLOPE OF NORTH AMERICA.*

BY CLOUDSLEY RUTTER.

The present paper contains studies of fishes from certain regions of the Pacific Slope, and is based on material in the museums of Leland Stanford Jr. University and the California Academy of Sciences. In its preparation I have been under many obligations to my teachers in ichthiology, Professor Charles H. Gilbert and President David S. Jordan. The paper is divided into four parts, each independent of the others.

I.

ON THE STICKLEBACKS OF CALIFORNIA, WITH SPECIAL REFERENCE TO THEIR INDIVIDUAL VARIATIONS.

The Sticklebacks of the Pacific Slope have been described under ten specific names. Of these ten nominal species, four—*Gasterosteus obolarius* Cuvier & Valenciennes, *Gasterosteus insculptus* Richardson, *Gasterosteus serratus* Ayers, and *Gasterosteus intermedius* Girard—have been shown by Jordan and Gilbert to be synonyms of *Gasterosteus cataphractus* (Pallas). Three—*Gasterosteus plebeius* Girard, *Gasterosteus inopinatus* Girard, and *Gasterosteus pugetti* Girard—are likewise known to be synonyms of *Gasterosteus microcephalus* Girard. The other species has been described under the one name only—*Gasterosteus williamsoni* Girard.

The chief character used in distinguishing these three recognized species is the completeness of the lateral armor. This armature consists of a series of vertical imbricated plates, which cover the whole side of the body anteriorly, becoming smaller posteriorly and forming a keel on the tail. So far as is known, *Gasterosteus cataphractus* is invariably fully plated from head to caudal fin. This species does not enter the streams. The typical *microcephalus* has the sides partly plated, and *williamsoni* has been described as entirely without plates. Both of these forms are chiefly confined to fresh water. It is of the variations in these two nominal species—*Gasterosteus microcephalus* and *Gasterosteus williamsoni*—that the present paper treats.

---

*Contributions to Biology from the Hopkins Seaside Laboratory. No. 6.

It was first noticed that the number of lateral plates in specimens of *Gasterosteus microcephalus* from San Francisquito Creek, which empties into San Francisco Bay at Palo Alto, was considerably less than that of specimens from San Gregorio Creek, which flows directly into the ocean on the opposite side of the peninsula. This led me to the inspection of specimens from other localities. In all, over twenty-two hundred specimens, representing thirty-nine localities, have been examined by me. Specimens from localities in the vicinity of Stanford University have been collected by various expeditions of the Department of Zoology. Mr. John M. Stowell collected in the San Miguel and San Luis Obispo creeks, Dr. Charles H. Gilbert and Dr. Wilbur W. Thoburn collected specimens in southern California. The Carmel River Expedition (N. B. Scofield, C. Rutter, A. Seale and C. J. Pierson) obtained specimens from the coastwise streams in the vicinity of Monterey Bay; specimens from Oregon and Washington have been secured by two expeditions of the U. S. Fish Commission; and Mr. E. C. Starks has furnished specimens from the vicinity of Seattle, Washington.

The chief variation is in the number of lateral plates.

When only a few plates are present, I have always found them to be those which join the post-pectoral plate below and the dorsal plates above. The post-pectoral plate, which is never wanting, is a wing of the pubic plate extending up the side behind the pectoral fin. The first plates to disappear are those in front of the caudal keel, the keel being next to go. Several specimens from brackish pools near Ballard, Washington, are an exception to this, the plates of the caudal keel being the only ones absent.

Below is given a table showing the variation in the number of lateral plates in specimens from different localities, the arrangement being in the order of the average number of plates. I here regard the whole series as forming one species, *Gasterosteus williamsoni*, with two varieties or subspecies, *williamsoni* and *microcephalus*, the latter being the prevalent form; the former, or typical form (because earliest known), originally described from near Saugus in Ventura county, Cal., being more local and confined to inland waters.

TABLE SHOWING THE VARIATION IN THE NUMBER OF PLATES IN *GASTEROSTEUS WILLIAMSONI.*

The number at the head of each column indicates the number of plates.

LOCALITY.	No. specimens examined	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Fully	Average Number
Santa Ana R., Colton, Cal.	44	43		½	½																			0
Santa Ana R., Riverside, Cal.	111	104	4	3																				0
Rio Salado, Mexico	3	1	½	½	1																			2
Santa Clara R., Ventura Co., Cal.	298	76	41	99	67	15																		2
Rio Pajaro, Santa Cruz Co., Cal.	4			1	1	2																		3
San Miguel Cr., San Miguel, Cal.	107	1	1	4		101																		4
La Laguna, Santa Maria R., Santa Barbara Co., Cal.	87	½	½	8	8	33	32	5																4
Gassus Cr., San Mateo Co., Cal.	129	5		1	5	5																		4
Santa Ynez R., Santa Barbara Co., Cal	129				2	35	61	28	3															5
Salinas R., Soledad, Cal.	173				1		170		1			1												5
Adobe Cr., Santa Clara Co., Cal.	115						115																	5
San Luis Cr., San Luis Obispo Co., Cal.	59				2		55		2															5
Unalaska	5						5																	5
Williamette R., Oregon City, Or.	1						1																	5
San Benito R., San Benito Co., Cal.	103						100							1		1							1	5
The Lakes, Williamette R., Albany, Or.	15					3	11	1																5
San Francisquito Cr., Palo Alto, Cal.	175						150		1	2	2	1	7		3	3	1						4	6
Lakes, vicinity of Seattle, Wash.	19						1	6	8	3	1													7
Carmel R., 25 mi. from mouth.	190						8	63	103	8	1		1				2	1		1			2	7
McKenzie R., Eugene, Or.	25						1	7	4	5	8													7
Deer Cr., Roseburg, Or.	3								1	2														8
Carmel R. (mouth) Monterey Co., Cal.	14				1	1	3	6	2					1							2			8

TABLE SHOWING THE VARIATION IN THE NUMBER OF PLATES IN *GASTEROSTEUS WILLIAMSONI*—CONTINUED.

The number at the head of each column indicates the number of plates.

LOCALITY.	No. specimens examined.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Fully	Average Number
Soquel Cr., Santa Cruz Co., Cal.	34					1	1		4	2	7	6	3	2	5		1		1				1	10
Pajaro R., Watsonville, Cal.	43					3	18	13						2		1	1	1		1			3	10
Skookemchuck Cr., Chehalis, Wash	39							1	11	6	1			2	3	1	2	1		1		1	9	13
Aptos Creek, Santa Cruz Co., Cal	2							1															1	15
Walla Walla R., Wallula, Wash.	46					1	3	1	3	5	1		2	2	2	3	1	3	2	3	4	2	8	15
Brackish Pools, Ballard, Wash.	57							1	2	2		1		2	1	2	3	2	1	3			37	20
San Gregorio Cr., San Mateo Co., Cal.	47									1	3		3		3	2		1	2	2	1	1	28	20
Scott Creek, Santa Cruz Co., Cal	11																						11	Fully
Liddel Cr., Santa Cruz Co., Cal.	1																						1	"
San Vicente Cr., Santa Cruz Co., Cal	41													1									40	"
Pescadero Cr., San Mateo Co., Cal.	4																						4	"
Wadell Cr., Santa Cruz Co., Cal.	46							1															45	"
Pilarcitos Cr., Spanishtown, Cal	100							1	1	1		1	3		1	4	3	2	1	2	1		79	"
Klaskanine R., Astoria, Or.	2																						2	"
North Umpqua R. Roseburg, Or.	14																						14	"

This table shows a complete gradation in the number of plates from specimens wholly naked to those fully plated. The specimens from the Santa Ana River are almost invariably without any plates. About one-fourth of those from the Santa Clara River in Ventura county are without plates, the others having from one to four. Into this stream flow the brooks of Williamson's Pass, which is the type locality of *Gasterosteus williamsoni*.

The specimens here noted agree with the original description of that species, except in the presence of plates as above noted. The original description was based on eight specimens. Our specimens from the San Miguel Creek have an average of four plates, only one having none. Adobe Creek furnishes 115 specimens, with from four to six plates. None of the 175 specimens from San Francisquito Creek have fewer than four plates, and four specimens are fully plated. The specimens from Walla Walla River range from four plates to a fully plated body, the average number of plates being fifteen. Seventy-nine per cent. of the specimens from Pilarcitos Creek, emptying into Half Moon Bay, are fully plated, but some have as few as six or seven. From several localities the specimens are all fully plated, but it is worthy of note that in such cases we have only a few specimens. Larger collections would doubtless show variation.

Dr. G. A. Boulenger has recorded similar variations in the English Stickleback, *Gasterosteus aculeatus*. The variations described by him were all found in one locality, in practically one haul of the seine. They correspond to those of our specimens from the Walla Walla River (see table).

From a number measurements, made with as much accuracy as the small size of some of the parts measured would permit, I find that the dorsal and ventral spines become shorter, the prepectoral area becomes slightly smaller, and the pubic plate shorter as the number of lateral plates grows less. There is little variation in the size of the head, the width of the thoracic area or the depth of the body. The proportionate size of the eye varies inversely with the size of the specimen, as usual in fishes. These variations are all such that those found in one locality overlap those found in another, thus forming a perfectly intergrading series from the plateless weak spined *williamsoni* to the fully plated, strongly armed form of *microcephalus*.

Other differences are as follows:

The tail of *microcephalus*, especially the more fully plated form, is somewhat depressed and rather slender. In the Colton and Riverside specimens (true *williamsoni)*, the tail is heavy, and it is somewhat compressed, or rounded. However this character shows great individual variation, and the well plated form of *microcephalns* differs as much from the poorly plated form as the latter does from *williamsoni*.

In the well plated forms the tail is provided with a keel on each side. This keel consists of a fleshy basis covered by the lateral plates, which here become keel-shaped. In the poorly plated form and in *williamsoni* the keel is absent.

The sides of the thoracic area are decidedly convex in *williamsoni*, becoming almost straight in the fully plated form of *microcephalus*. The post pectoral plate is heavier and notched in the more completely plated specimens. The pubic plate is more sharply pointed and more firmly attached to the interclavicles when the lateral armor is more complete. The first dorsal plates, those in front of the first dorsal spine, are small or wanting in the naked specimens, becoming larger and more firmly attached as the lateral armature becomes more completely developed.

The specimens of *williamsoni* that I have seen are smaller than the average of *microcephalus*.

There are fully intergrading series in these variations also.

The following is a summary of the points in which variations exist and which may be used in distinguishing the two varieties. The average representative of the parent form, called *microcephalus*, as compared with the average representative of the derived form, *williamsoni*, has:

1. The sides with more plates.
2. The pre-pectoral area larger.
3. The pubic plate longer and sharper.
4. The caudal peduncle or tail more slender.
5. The dorsal and ventral spines longer.
6. The pelvic girdle more firmly attached to the interclavicles.
7. The post-pectoral plate heavier.
8. The sides of the thoracic area less convex.
9. The first dorsal plates larger and more firmly attached.
10. A larger average size of the adult individual.

The fin rays are: *williamsoni*, dorsal 9 to 12, anal 7 or 8; *microcephalus*, dorsal 10 to 13, anal 7 to 9.

These numerous differences, together with the difference in distribution, necessitate the separation of *microcephalus* and *williamsoni*, but the fact that the differences all intergrade in intermediate territory, gives these forms only subspecific value. As the name *williamsoni* is the older, it must be used as the specific name, while the common or parent form must be recorded as *Gasterosteus williamsoni microcephalus*.

The true *williamsoni*, with the exception of the eight type specimens, is known only from the Santa Ana Basin at Colton, Riverside and San Bernardino. The form called *microcephalus* is known from many streams from Unalaska on the north to the Santa Clara River on the south, where it meets *williamsoni*, the types of *williamsoni* being from a tributary of the Santa Clara.

The variety *microcephalus* shows great variations, but I have been unable to coördinate them with any locality or stream condition. The most that can be said is that the more fully plated specimens have been taken in small coastwise streams, while the less fully plated ones usually, though not always, have been found farther inland. In general, there is no doubt that the forms having the armature more fully developed are nearer the primitive type. These live near the sea. These facts point to the descent of the species from *Gasterosteus cataphractus*.

The marine species, *Gasterosteus cataphractus*, itself shows little variation. It differs from the well plated form of *microcephalus* in having a more slender and compressed body, longer spines, longer pectorals, larger prepectoral area, more depressed caudal peduncle, and narrower pubic plate and thoracic area. These, again, are all differences of degree, and they point to the recent origin of *microcephalus* and *williamsoni*, brackish and fresh water forms, derived from those strictly marine. In like manner, doubtless, the partly naked fresh water forms of Eastern America and Europe have sprung from the marine species of the same region.

TABLE OF MEASUREMENTS.

(Specimens selected to show greatest variation.)

		Length of specimen in mm.	Head in length to base of C.	2d D. Sp. in length.	V. Sp. in length.	Pre-pectoral area in length.	Pubic plate in length.	Pubic plate, length + width.	Thoracic area, length + width.	Eye in length.	Depth in length.	Average number of plates from the locality.
	Pilarcitos Creek.	45.0	3.00	11.6	7.4	9.4	6.0	2.4	2.0	11.0	3.7	Fully Plated.
		39.3	3.12	7.9	5.5	9.4	5.3	2.8	1.6	11.5	3.8	
		41.4	3.16	8.1	5.7	8.8	6.1	3.0	2.2	11.8	4.1	
		46.6	3.05	9.5	7.1	9.5	6.0	2.1	1.5	11.0	3.7	
		24.5	3.40	6.8	6.0	9.4	6.1	3.3	1.9	9.8	3.6	
	San Francisquito Creek.	55.0	3.44	10.0	8.5	10.2	6.0	2.8	1.5	12.0	4.2	Six.
		52.8	3.24	10.6	7.7	8.9	5.8	2.4	1.5	12.0	4.1	
		53.9	3.81	11.7	7.8	8.7	5.7	2.5	1.7	12.5	4.1	
		56.2	3.45	10.0	7.6	9.9	5.8	2.7	1.5	12.2	4.0	
		55.3	3.35	10.4	7.8	9.1	5.8	2.7	1.6	12.0	4.0	
		54.0	3.21	10.6	7.7	8.7	5.7	2.5	1.3	11.5	3.7	
		61.5	3.59	9.6	7.4	9.8	5.3	2.5	1.6	13.4	3.4	
		37.0	3.22	10.6	7.4	9.5	6.9	3.2	2.2	11.6	4.1	
		35.7	3.29	7.3	5.7	9.4	5.9	3.8	2.0	11.5	4.0	
	San Miguel Creek.	48.2	3.65	12.0	9.1	9.2	7.8	2.7	2.2	14.5	4.3	Four.
		35.3	3.22	11.4	7.5	8.8	6.8	2.5	2.2	11.0	3.9	
		51.0	3.40	12.7	10.2	9.3	6.9	2.0	1.8	13.4	3.9	
		54.0	3.40	12.0	9.6	10.0	6.4	2.7	1.7	12.3	3.9	
		36.9	3.30	9.2	7.5	9.5	7.0	2.8	1.9	12.3	4.1	
	Riverside.	44.3	3.05	15.8	10.8	9.6	7.3	2.3	2.4	12.4	3.8	None.
		40.0	3.03	16.0	13.3	11.1	7.6	2.8	1.7	11.1	4.0	
		37.3	3.01	9.8	9.3	10.6	6.9	2.6	1.6	11.0	4.1	
		43.0	3.33	12.6	9.6	11.3	7.5	2.9	2.4	12.0	4.3	
		44.7	3.08	14.9	14.4	10.2	7.7	2.3	2.0	12.4	4.3	
		23.6	3.28	8.7	7.8	9.1	9.1	2.6	1.8	10.7	3.8	
	Colton.	36.0	3.00	14.4	10.0	10.7	7.5	3.0	1.5	10.7	3.6	None.
		34.1	3.37	13.6	10.0	11.0	9.7	2.2	2.6	11.8	4.2	
		32.0	3.33	12.8	10.0	10.7	8.8	2.6	1.9	10.7	3.9	
Maxima.	Pilarcitos		3.00	6.8	5.5	8.8	5.3	2.1	1.5	9.8	3.6	Fully Plated.
	San Francisquito.		3.21	7.3	5.7	8.7	5.3	2.4	1.3	11.5	3.4	Six.
	San Miguel		3.22	9.2	7.5	8.8	6.4	2.0	1.7	11.0	3.9	Four.
	Riverside		3.01	8.7	7.8	9.1	6.9	2.3	1.6	10.7	3.8	None.
	Colton............		3.00	12.8	10.0	10.7	7.5	2.2	1.5	10.7	3.6	None.
Minima.	Pilarcitos.........		3.40	11.0	7.4	9.5	6.1	3.3	2.2	11.8	4.1	Fully Plated.
	San Francisquito.		3.59	11.7	8.5	10.2	6.9	3.8	2.2	13.4	4.2	Six.
	San Miguel.......		3.65	12.7	10.2	10.0	7.8	2.8	2.2	14.5	4.3	Four.
	Riverside.........		3.33	16.0	14.4	11.3	9.1	2.9	2.4	12.4	4.3	None.
	Colton...		3.37	14.4	10.0	11.0	9.7	3.0	2.6	11.8	4.2	None.
Mean, with variation from the mean.	Pilarcitos.........		3.20	8.9	6.4	9.2	5.7	2.7	1.8	10.8	3.9	
	"		.20	2.1	1.0	.4	.4	.6	.4	1.0	.3	Fully Plated.
	San Francisquito.		3.40	9.5	7.1	9.5	6.1	3.1	1.8	12.5	3.8	
	"		.19	2.2	1.4	.8	.8	.7	.5	1.0	.4	Six.
	San Miguel		3.44	11.0	8.9	9.4	7.1	2.4	2.0	12.8	4.1	
	"		.22	1.8	1.4	.6	.7	.4	.3	1.8	.2	Four.
	Riverside		3.17	12.3	11.1	10.2	8.0	2.6	2.0	11.6	4.1	
	"		.16	3.7	3.3	1.1	1.1	.3	.4	.9	.3	None.
	Colton............		3.19	13.6	10.0	10.9	8.6	2.6	2.1	11.3	3.9	
	"		.19	.8	.0	.2	1.1	.4	.6	.6	.3	None.

II.

THE FISHES OF RIO YAQUI, SONORA, WITH THE DESCRIPTION OF A NEW GENUS OF SILURIDÆ.

This report is based on two small collections of fishes, one of two species made by Dr. Gustav Eisen at Hermosillo, and the other of six species by Mr. William Wightman Price, in the headwaters of Rio Yaqui, in northern Sonora and southern Arizona. The only collections heretofore reported from Sonora were made in San Bernardino Creek by the Mexican Boundary Survey. No species other than those here reported were obtained at that time.

Dr. Eisen obtained his specimens from a tributary of the Rio Sonora, near Hermosillo, the capital of Sonora, while in charge of the exploring expedition sent out by the California Academy of Sciences in 1892. He gives the following notes on the stream in question:

The Sonora River at Hermosillo is a shallow stream, with so little water during the dry season that the stream becomes almost dry. Most of the water is taken out for irrigation above town, leaving the sandy bed dry below. In summer time after heavy rains, however, the water rises quickly and Rio Sonora may then become a torrent of several days' duration. East of Hermosillo the water increases rapidly, and even during the dry season may be several feet deep. The fishes collected were found in pools in the sandy bed, fed by a tiny streamlet in places simply percolating through the sand.

Mr. Price obtained specimens of fishes in 1894 while collecting birds and mammals in the mountains of southern Arizona and northern Sonora. His stations were (1) the Rio Yaqui, east of Oposura; (2) its tributary, San Bernardino Creek, at a point just south of the Arizona line; (3) Morse Cañon, and (4) Rucker Cañon, small creeks in the Chiricahua Mountains, Arizona, which belong to the Yaqui Basin, although their waters disappear in the sand long before reaching any direct tributary of that stream. Mr. Price says that the region is much elevated, and, except in the mountains, nearly barren. The courses of the streams of Rucker and Morse cañons, and others similar in which he did not collect, can be traced for several miles into the desert, through which the water doubtless flows during freshets, but there is no evidence that it has reached the Yaqui in recent years.

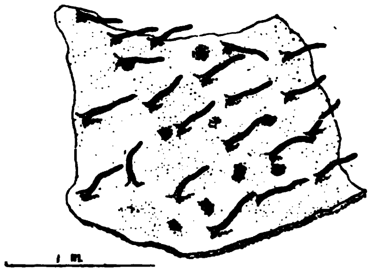
Mr. Price's collection adds the family Siluridæ and the genus Campostoma to the list of types found in Pacific waters, this being the most northern record of a fresh water catfish on the Pacific slope, and the first record of *Campostoma* from the west slope. The species has been named *Campostoma pricei* by Jordan & Thoburn, but the species seems to be identical with *Campostoma ornatum* of the Rio Grande basin, an unexpected and curious fact, as the two basins are separated by the continental divide. The basin is more closely connected with that of the Gila, all of the species found in the former, excepting the new catfish and the *Campostoma* being found in the latter.

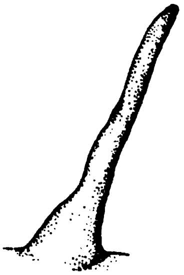
Family SILURIDÆ.

Villarius Rutter, new genus.

Allied to *Ameiurus*, differing in the presence of scattered cilia on the sides.

Backward process from occipital short, broad, emarginate, connected by ligament with the first interspinal buckler. In adults, the distance between this process and the buckler is equal to the length of the former; in young specimens the process overlaps the keel on the underside of the buckler. Head narrow, width of intermaxillary band of teeth ⅓ of head. Caudal deeply forked, the upper lobe the longer. Barbels long, those of the maxillary extending past the gill opening. *Sides with scattered hair-like cirri.* These are very noticeable under a lens, but not readily distinguished by the naked eye.





This genus differs from all others of the family in having hair-like cirri on the sides. It differs from *Ictalurus* in having the occipital process and the interspinal buckler widely separated and connected by ligament; from *Ameiurus* in having a narrow head and a deeply forked caudal.

1. **Villarius pricei** Rutter, new species.

B. 8; D. I, 6; A. 22 to 23; C. 17; P. I, 9; V. 8.

Head 3⅓ to 3¾ in body; eye 5 to 7, snout 2⅔, maxillary 5½ to 6 in head. Maxillary barbel very long, reaching beyond the pectoral spine, in the adult specimen about to its tip when depressed, 3 to 4 times as long as the barbel at nostril. Origin of dorsal midway between snout and middle of base of adipose fin; pectorals inserted halfway between snout and ventrals. Longest dorsal ray six to seven times in length of body; spine of dorsal longer than its base, equal to base of adipose fin. Longest pectoral ray about half of head, pectoral spine 2½ to 3 in head, with about twelve distinct hooked serræ behind, these fewer and somewhat smaller in a specimen 17 in. long. Base of anal three times in its distance from snout, its longest rays equal to those of the ventral. Caudal deeply forked. Lateral line present, but rather faint.

This species is closely related to the species described by Bean as *Ameiurus dugesii* (Proc. U. S. Nat. Mus., 1879, 304), differing in having very prominent serrations on the pectoral spines, the types of *dugesii* having the pectoral spines without serræ. I have examined a specimen of *dugesii*, 4 in. long, from Salamanca, Mex., which is in the type basin. It has the cirri minute and light in color, a row of papillæ along the lateral line, and the pectoral spines with four or five degenerate serræ. The process from the occipital is as described above, and Mr. Bean informs me that the types have the sides with hair-like cirri. It, therefore, belongs in the same genus with *pricei* and may stand as *Villarius dugesii*.

This description is based on seven specimens (No. 4826, L. S. Jr. Univ.), 7 to 17½ in. long, from San Bernardino Creek, near the northern border of Sonora, Mexico.

The species is named for the collector, Mr. William Wightman Price.

Family CATOSTOMIDÆ.

2. **Catostomus bernardini** Girard.

Several specimens, in poor condition, 2¼ to 3½ in. long, from Rio Yaqui, Sonora.

Head 3½ to 3, depth about 4 to 4½ in length; eye 3⅔ to 4¼ in head, 1½ in snout. D. 11; A. 7. Scales 10 to 12–64 to 73–10 to 12, 26 to 30 before dorsal. Lips very large, about four rows of papillæ on upper, lower incised to base, the lobes rounded.

Family CYPRINIDÆ.

3. **Campostoma ornatum** Girard. (*Campostoma pricei* Jordan & Thoburn.)

Five specimens, 1½ to 4 in. long, from Rucker Cañon, Chiricahua Mountains, Ariz.

Head 3½ to 4 in length; eye 3⅔ to 4½ in head, 5⅓ in an adult male; 31 to 35 scales before dorsal [31, 34, 35, 35]. Origin of dorsal midway between nostrils and rudimentary caudal rays. Maxillary extending to below anterior nostril; top of head 1½ in distance from occiput to dorsal (1¼ in one specimen).

These specimens are from the exact type locality of the specimen upon which Jordan and Thoburn based their description of *Campostoma pricei* (Fishes of North America, Jordan and Evermann, p. 205), and their type specimen is included in the notes here given. The receipt of more material and its comparison with specimens from Rio Conchas, Chihuahua, Mex., shows the species *pricei* not to be valid. The measurements for the Rio Conchas specimens are: Head 3½ to 3⅘; eye 4½ to 5; scales before dorsal 32 to 39; [32, 33, 36, 37, 37, 38, 39]; origin of dorsal and maxillary as given above; top of head 1½ in distance from occiput to dorsal, 1⅖ in one specimen.

The convolutions of the alimentary canal in these specimens are quite different from those of *Campostoma anomalum*. Instead of having the alimentary canal wound around the air-bladder a number of times, it is folded back and forth antero-posteriorly below and at the side and makes only one fold on top, not going entirely around it at all. The intestines were found to have the same arrangement in a specimen of *Campostoma ornatum* from Rio Conchas, Mexico. In one of our specimens, a female, the alimentary canal was entirely below the air-bladder. In a specimen of *Campostoma anomalum* from Ross Lake, near Cincinnati, Ohio, the alimentary canal was wound around the air-bladder more than a dozen times, though the ovaries were not thus inclosed.

4. **Leuciscus purpureus** Girard.

One specimen 1¼ inches long from Morse Cañon, and three of the same length from the Yaqui River, east of Oposura, are identified provisionally but very doubtfully with this species. The one from Morse Cañon has the head 3½, depth 3⅔ in length, eye 3½ in head, longer than snout. Dorsal 9, anal 7, lat. l. 53. Teeth 1, 4–5, 1. The three from the Yaqui have the following description:

Head 3¾ in length, eye 3½ in head, a little longer than snout. Dorsal 9, anal 7, lat. l. 70, complete. Teeth 4–4, hooked, with flat or slightly grooved grinding surface. Maxillary about to vertical from anterior margin of eye, slipping under the preorbital, without barbel. Mouth oblique, head pointed, lower jaw included. Dorsal inserted over ventrals; anal deep, pointed. Olive above, silvery below, sides and back finely dusted with black. Lateral band, caudal spot, and a median dorsal line, black.

5. **Agosia chrysogaster** Girard.

Numerous specimens from Rucker Cañon, the largest about three inches long, and one small specimen from Morse Cañon; also three specimens 1½ inches long from Hermosillo.

Dorsal 8, anal 7. Head 3⅜ to 4, depth 3¾ to 4 in length; eye 3½ to 4 in head, longer than snout in the smaller specimens. Mouth low, terminal, scarcely oblique, the lower jaw included; premaxillaries protractile; maxillary to below nostril in the larger specimens, with barbel at extremity. Teeth 4–4, hooked, with deeply grooved grinding surface. Scales very small, about 17–70 to 80–14, lateral line incomplete posteriorly. Alimentary canal 1¼ times length of body; peritoneum black. Dorsal inserted behind ventrals, the latter reaching the vent. Anal deep, extending when depressed half way from its hinder margin to caudal.

Color of Hermosillo specimens, in alcohol, a dark median dorsal stripe, a dark lateral band, above which the sides are brown; under parts silvery; sides in and above the lateral band finely dusted with black; a distinct black spot at base of caudal; fins all pale. The specimens collected by Mr. Price have lost their color markings.

6. **Pœcilia occidentalis** (Baird & Girard).

Numerous specimens from the Yaqui, east of Oposura, collected by Mr. Price, and from Hermosillo, collected by Dr. Eisen. The following description is based on the latter, those collected by Mr. Price not differing materially. This species, as Mr. Garman has shown, is a true *Pœcilia*, not a *Heterandria:*

Dorsal 7 or 8; anal 7; ventral 6. Scales 28–7. Head 3⅔ to 4 in length, depth 3½ to 4. Eye 3⅓ in head, equal to or slightly longer than snout, a little less than two times in interorbital width. Teeth in a double crescentric row in each jaw, with a series of minute teeth behind them, not readily appreciable. Origin of dorsal in middle of total length in females, more anterior in males; behind the anal in males, where it is nearer pectorals than caudal, above posterior rays of anal in females. Anal process 1⅗ to 2 times head, in some specimens extending to caudal, bent to one side at its extremity with minute serrulations. Adult males have the ventral fins very small and placed almost below the pectorals; the females have them larger and inserted below the tips of the pectorals.

Several specimens, which are doubtless immature males, resemble the females, except in having the anterior rays of the anal somewhat elongate, but not yet developed into a true anal process. Anal basis short, four times in lower side of caudal peduncle.

Color, in alcohol, a dark lateral band usually present on posterior half of body, with a distinct black line through its middle. A black line present on lower side of caudal peduncle. Scales edged with dark. Females otherwise very light, the fins unmarked. Adult males very dark, all fins with dark shadings; young males resembling the females in color.

Of the thirty-three specimens collected by Dr. Eisen, three are adult males and five or six others seem to be immature males. The largest male is 1 inch, the largest female 1¼ inches. The largest collected by Mr. Price are, male 1¼ inches, and female 2¼ inches.

Mr. Price also fished Sabino Cañon, a tributary of the Santa Cruz, of the Gila Basin, obtaining *Leuciscus intermedius* and *Pœcilia occidentalis;* and from the Rio San Pedro at Fairbank, Arizona, also in the Gila Basin, he obtained *Pantosteus clarki* and *Agosia chrysogaster.* I have the following note on

Leuciscus intermedius (Girard):

Head 3⅓ to 3¾, depth 4 in length; eye equal to snout, 1 to 1¼ in interorbital, 3¾ to 4 in head. Teeth normally 2, 5–4, 2, but 1, 5–4, 1 and 0, 5–4, 1 and 0, 4–4, 0 also found, the tips black in some specimens. Dorsal 8 or 9, anal 7 or 8; scales 17 to 20—64 to 73—7 to 9, lateral line much decurved. Anal fin deep, longest ray twice length of base.

III.

NOTE ON A COLLECTION OF FISHES MADE IN STREAMS NEAR CAPE SAN LUCAS BY DR. GUSTAV EISEN.

A small collection of fishes, consisting of nine species, was obtained by Dr. Gustav Eisen in fresh water streams about Cape San Lucas, in Baja California. The species are all well known, but their occurrence in this region is worthy of record.

1. **Siphostoma starksi** Jordan & Culver.

Numerous specimens of this species from San José del Cabo. They differ somewhat from the types of *Siphostoma starksi* in having a longer body and shorter tail, though there is considerable variation in both lots of specimens.

Head 10½ to 10⅔; dorsal 37 to 39; pectoral 13. Head 3¾ to 4 in distance from snout to vent; head and body 1¾ to 1⅘ in tail; snout 2½ to 2⅗ in head. Two lateral keels on body, the upper ceasing and the lower curving upward under posterior part of dorsal, as in the types. Dorsal beginning over, or in some specimens, one segment behind vent. Color quite dark, a rather regular series of light-colored dots along sides; middle rays of caudal black, outer with irregular blotches.

2. **Agonostomus nasutus** (Günther).

One specimen, 4¼ inches long, from San José del Cabo. It agrees in all essential characters with the original description, which was based on a specimen 8½ inches long from the Rio San Geronimo in Guatemala. The eye, however, is 3½ in head, 4⅕ in an 8-inch specimen from Mazatlan, instead of 5; the caudal is emarginate, the middle rays ⅗ length of outer. The soft dorsal is not so high as the spinous dorsal and is as high as the anal, instead of being higher than the spinous dorsal and lower than the anal.

Head $3\frac{4}{5}$, depth $3\frac{2}{5}$ in length; dorsal IV–I, 8; anal II, 10. Of specimens from Mazatlan, some have the anal II, 10, and some III, 9. The lateral line is faintly indicated; scales 6–44–6, 19 before dorsal, extending forward to anterior margin of pupil. Preorbital serrate on lower edge, the serræ not evident on larger specimens from Mazatlan. Pectoral $1\frac{2}{5}$ in head, not quite equal to distance from nostril to margin of opercle. All fins, except the spinous dorsal, have scales on the basal part, and it has an elongate accessory scale on each side. The fourth spine of the dorsal is weak.

3. **Mugil albula** Linnæus. LA LIZA.

Two specimens, 9 in. long, from fresh water at San José del Cabo. Head 4 in length. Scales 38 and 39. Dorsal and anal scaled on anterior rays only.

4. **Mugil curema** Cuvier & Valenciennes. TRUCHA: LIZA.

Numerous specimens, 1½ to 8 in. long, from La Paz, and from Rio San José, San José del Cabo. This and the preceding are marine species, although frequently ascending rivers.

5. **Eucinostomus californiensis** (Gill). LA MAJARRA.

One specimen, 4½ in. long, from fresh water at San José del Cabo. It agrees with specimens from Panama.

Dorsal VIII, 9, its longest spine about 1¾ in head; eye $2\frac{4}{5}$ in head, longer than snout.

6. **Philypnus lateralis** Gill.

One specimen, 3½ in. long, from fresh water at San José del Cabo.

Dorsal VI–I, 9; anal I, 11.

7. **Dormitator maculatus** (Bloch.) PARGETA, LA PAJEQUE.

Nine specimens, 2¼ to 4¼ in. long, from Rio San José, San José del Cabo.

Head 3⅓, depth 3½ in length. Dorsal VII–I, 8; anal I, 9. According to Dr. Eisen, the spot in front of the pectoral is blue in life.

8. **Eleotris pictus** (Kner & Steindachner). (*Eleotris æquidens* Jordan & Gilbert.)

Eight specimens, 3 to 14 in. long, from fresh water at San José del Cabo. They agree with the original description by Jordan & Gilbert, except in minor details.

Head 3 to 3⅓ in length; maxillary 2½ to 2¾ in head; scales 61 to 68, 25 or 26 in an oblique series downward and backward from the origin of the dorsal. Eye 2 to 2¾ in interorbital width, the latter in a specimen 14 in. long. No conspicuous knobs at upper anterior and posterior margins of orbit; if such were conspicuous in the types, they were probably due to shrivelling. Preopercular spine covered by the skin.

Dr. Gilbert informs me that *Eleotris æquideus*, of which species he has specimens from Panama, is identical with the form earlier known as *Eleotris pictus*.

9. **Awaous taiasica** (Lichtenstein). LA PUJEQUE, MUCHURA.

Six specimens, 2¼ to 3½ in. long, from Rio San José, San José del Cabo.

Dorsal VI–I, 10, the first ray of the second dorsal being unsegmented; eye 4½ to 5 in head. The anterior profile of the head is much curved, as is the case with smaller specimens from Mazatlan.

10. **Spheroides annulatus** (Jenyns).

Five specimens, 3 to 3½ in. long, from La Paz. The bar at base of pectoral is indistinct, and there is a pale edging at tip of caudal.

IV.

DESCRIPTION OF A NEW SPECIES OF CHARACONDON FROM TEPIC, MEXICO.

Characodon eiseni Rutter, new species.

Head 3½; depth 3¼; eye 3. Dorsal 11 to 13; anal 13; scales 30 to 32, 12. Snout shorter than eye, lower jaw projecting. About nine teeth in upper jaw and about 14 in lower. Teeth strongly bicuspid, the villiform teeth not developed. Mouth almost vertical when closed, mandible about half length of eye. Interorbital space flat, the anterior part equal to orbit, wider posteriorly. Insertion of dorsal in middle of total length; anal inserted under 4th ray of dorsal. Pectoral reaching past insertion of ventral. Tips of depressed dorsal and anal in vertical through middle of caudal peduncle. Caudal broad, truncate, length of middle rays equal to length of top of caudal peduncle. Head about ¼ of total; greatest depth of body above ventrals. Depth of caudal peduncle ½ its length. Color, in alcohol: Male with a broad indefinite lateral band; female with dark blotches on sides which in one of three specimens form distinct cross-bands.

This species is most closely related to *Characodon variatus* Bean, which is found in the headwaters of the same basin. It differs from that species in having fewer rays and scales, much fewer teeth, larger eye, much more posterior position of dorsal, and in color.

This description is based on four specimens (No. 4999,

L. S. Jr. Univ. Mus.), the largest 1¼ inches long, from a branch of the Rio Grande de Santiago at Tepic, Mexico.

The species is named for Dr. Gustav Eisen, who collected it with the following species in 1894:

Pœcilia occidentalis (Baird & Girard).

Numerous specimens of this species were taken with the above. They do not differ from specimens from Hermosillo.

DESCRIPTION OF A NEW SPECIES OF PIPE-FISH (SIPHOSTOMA SINALOÆ) FROM MAZATLAN.

BY DAVID STARR JORDAN AND EDWIN CHAPIN STARKS.

Siphostoma sinaloæ Jordan & Starks, n. sp.

Allied to *Siphostoma arctum* Jenkins & Evermann.

Head 8½ in length to base of caudal; depth 3½ in head; dorsal 26, on 1½ + 5 rings 14 + 35.

Snout 1¼ in head, a strong median ridge above running to between middle of eyes, a ridge on each side from angle of mouth to below eye, occipital and nuchal plates keeled, a slight keel on anterior part of opercle: dorsal keels ceasing in front of the last four or five rays of dorsal, the lateral ridge running up and continuing as dorsal ridges; belly with a keel on each side. Preanal part of belly 1¾ in postanal part; pectoral shorter than eye; caudal 3 in head.

Color olive brown above, abruptly lighter below lateral ridges anteriorly, the edges of the plates dark, forming reticulations on lower parts of body, between every four rings is a narrow white cross-bar; from each eye is a narrow light bar running upward and backward to occiput; caudal dark.

The two type specimens, one of which was sent to the British Museum, were collected by the Hopkins Expedition at Mazatlan. They were erroneously referred to *Siphostoma arctum* in our paper on the Fishes of Sinaloa, Proc. Cal. Acad. Sci., 1895, 416.

Type No. 2945, L. S. Jr. Univ. Museum.

NOTE ON DELTISTES, A NEW GENUS OF CATOSTOMOID FISHES.

BY ALVIN SEALE.

In studying the skulls of the different species of *Chasmistes*, a genus of Suckers characteristic of the landlocked lakes of the Great Basins of Utah, Nevada, and Oregon, I observed a notable difference in the form of the gill-rakers of *Chasmistes luxatus* Cope, as compared with the other species. In this species the gill-rakers are broad, shaped like the Greek letter △ (delta), and their edges are unarmed and entire. In the other species referred to *Chasmistes*, the gill-rakers are, as in *Catostomus*, narrower and marked with a fringe of fine teeth on the inner dorsal margin. This character seems to be of generic value, and the name *Deltistes* is here proposed for the group typified by *Deltistes luxatus*. In both *Chasmistes* and *Deltistes* the lower pharyngeals are weak, with numerous small teeth.

I may further note that *Catostomus fecundus* Cope, is a species of *Chasmistes*, and that the genus *Lipomyzon* Cope, cannot be separated from *Chasmistes*.

The known species of *Chasmistes* may be thus distinguished:

a. Scales moderate, 60 to 65 in lateral line.
  b. Mouth small; nose with a prominent hump, formed by the extension of a small "pre-nasal" bone between the bases of the premaxillary spines; scales 8–64–9; dorsal rays 11. Utah Lake. *fecundus* Cope.
  bb. Mouth large; hump on snout rather less prominent; lips thinner and smooth.
    c. Scales 10–62–9; dorsal rays 11. Utah Lake. *liorus* Jordan.
    cc. Scales 13–65–11; dorsal rays 12; head very wide. Pyramid Lake. *cujus* Cope.
aa. Scales small, 72 in lateral line; snout short, without prominent hump; cranial surface smooth; scales 12–72–11; dorsal 11; mouth rather small. Klamath Lake. *brevirostris* Cope.

PROC. CAL. ACAD. SCI., 2D SER., VOL. VI. June 27, 1896

LELAND STANFORD JUNIOR UNIVERSITY PUBLICATIONS

CONTRIBUTIONS TO BIOLOGY

FROM

THE HOPKINS SEASIDE LABORATORY.

VII

NEW MALLOPHAGA,

II,

FROM LAND BIRDS, TOGETHER WITH AN ACCOUNT OF THE MALLOPHAGOUS MOUTH-PARTS.

BY

VERNON L. KELLOGG,

Professor of Entomology, Leland Stanford Jr. University.

Leland Stanford Jr. University,
Palo Alto, California,
1896.

LELAND STANFORD JUNIOR UNIVERSITY PUBLICATIONS

CONTRIBUTIONS TO BIOLOGY

FROM

THE HOPKINS SEASIDE LABORATORY.

VII

NEW MALLOPHAGA,

II,

FROM LAND BIRDS, TOGETHER WITH AN ACCOUNT OF THE MALLOPHAGOUS MOUTH-PARTS.

BY

VERNON L. KELLOGG,

Professor of Entomology, Leland Stanford Jr. University.

(Reprint from the Proceedings of the California Academy of Sciences, Series 2, Vol. VI.)

LELAND STANFORD JR. UNIVERSITY,
PALO ALTO, CALIFORNIA,
1896.

AUTHOR'S PREFACE.

The following paper presents the descriptions and figures of thirty-three new species of Mallophaga, together with the identifications and figures of sixteen species previously described by European authors, but now, with few exceptions, first determined as parasites of American birds. All of these species have been collected, mostly by the author and Mr. R. E. Snodgrass, from land birds as opposed to water or shore birds. (As No. iv, 1896, of this series of "Contributions to Biology from the Hopkins Seaside Laboratory," under the title "New Mallophaga, I......," the author published the descriptions and figures of one new genus and thirty-eight new species of Mallophaga, with the identifications and figures of twenty-two previously described species, all from water and shore birds. In New Mallophaga, I, was given a "brief account of the structure, external and internal, of the life-history and habits, and of the zoological and geographical distribution of the parasites, together with a review of the literature of the group, and a statement of the present systematic treatment of the order, with a synopsis and tables of the families and genera"; the paper is intended to serve American students as an introduction to the study of the group.)

In the present paper there is also presented a somewhat detailed account of the mouth parts of several genera of Mallophaga, and an account of the mouth parts of the Psocidæ, Perlidæ, Termitidæ, groups which have been variously classed with or close to the Mallophaga, sufficiently full to make an intelligent comparison of the mouth structures of these various groups possible. Some light seems to be thrown by this study on the phylogeny of the Mallophaga.

Types of the new species described will be placed in the collections of this University, in the collections of the California Academy of Sciences, and in those of the University of Kansas. The author has to express his obligations for services kindly rendered in connection with the preparation of this paper to Mr. F. J. Jack, artist, to Prof. Walter Miller, and to Mr. R. E. Snodgrass, who collected most of the specimens recorded from Californian birds, and whose careful work on the anatomy of the mouth parts is elsewhere more definitely referred to.

V. L. K.

STANFORD UNIVERSITY, September, 1896.

NEW MALLOPHAGA, II,—FROM LAND BIRDS; TOGETHER WITH AN ACCOUNT OF THE MALLOPHAGOUS MOUTH-PARTS.

(With Plates lx–lxxiii.)

BY VERNON L. KELLOGG.

CONTENTS.

The Mouth-parts of the Mallophaga.
  - Introduction.
  - The Mouth-parts of Ancistrona gigas.
  - The Mouth-parts of Læmobothrium sp.
  - The Mouth-parts of Eurymetopus taurus.
  - The Mouth-parts of Goniodes cervinicornis.
  - Resumé.

The Mouth-parts of Some Allied Insects.
  - The Mouth-parts of the Termitidæ and the Perlidæ.
  - The Mouth-parts of the Psocidæ.
  - Comparison and Conclusions.

Descriptions of New Species, and Identifications of Old Species.
  - Docophorus.
  - Nirmus.
  - Lipeurus.
  - Goniodes.
  - Goniocotes.
  - Physostomum.
  - Colpocephalum.
  - Menopon.
  - Nitzschia.

List of Hosts, with Parasites.
  - Notes on Distribution.
  - List.

THE MOUTH-PARTS OF THE MALLOPHAGA.

The mouth-parts of the Mallophaga are of the biting Orthoptero-Neuropterous type; that is, they are of that generalized kind of insectean mouth-parts in which there are free, strong, laterally working mandibles, free jaw-like maxillæ composed of distinct basal sclerites, articulated terminal lobes and segmented palpi, and a labium composed of the fused second maxillæ with similar basal and terminal sclerites and segmented palpi. But the Mallophagous mouth-parts represent a modified, a specialized condition of this simple type, in which the reduction of the maxillæ with the complete loss of their palpi and (in one suborder) the loss of the labial palpi, so confuse, at first glance, the homologies of the various structures, as to make the proper understanding of the mouth-parts a matter requiring some special attention.

Nitzsch, the first student of the Mallophaga, misunderstood the structure of the mouth-parts, holding the labial palpi to be maxillary palpi (see figs. 1, 2 and 3, plate lx), and his error was not corrected until Grosse*, in his careful dissections of *Tetraophthalmus chilensis* [=*Menopon titan*], made the matter plain.

† Rudow gives a most confused account of the mouth parts, having evidently made very superficial observation, although he declares himself to have made a most careful and exhaustive study of them. He concluded, from observation of the hypopharynx, that the Mallophaga should be classed with the sucking insects, and particularly with the Hemiptera. ‡ Melnikoff thought the peculiar chitin structure in the pharynx (referred to later as the œsophageal sclerite) to be homologous with the sucking structures of the Pediculidæ, and therefore held the Mallophaga to be true sucking in-

---

* Grosse, Franz. Beiträge zur Kenntniss der Mallophagen. Zeitsch. f. wiss. Zool., vol. xlii, 530, p. pl. xviii, 1885.

† Rudow, Fred. Beobachtungen über Lebenweise u. Bau der Mallophagen o. Pelzfresser. Zeitschr. f. ges. Naturwiss., vol. xxxv, 1870, pp. 288–298.

‡ Melnikoff, N. Beiträge zur Embryonalentwicklung der Insekten. Archiv. f. Naturgesch., 1869. p. 136.

sects. *Denny, †Giebel, ‡Piaget and §Taschenberg add nothing in their monographs to our knowledge of the mouth-parts. Giebel repeats Nitzsch's explanation of them; Piaget refers the palpi of the Liotheidæ to the maxillæ, and also says the labium of the Philopteridæ has 2-segmented palpi, referring doubtless to the paraglossæ; Taschenberg in his passing reference to the mouth-parts repeats Piaget's statements. ‖Grosse was the first to understand and to explain what seems really to be the true structure and homologies of the mouth-parts. He first indicated the labial character of the conspicuous palpi which are present in all of the Amblycera, called the labial palpar-like processes paraglossæ (see figs. 4 and 5, plate lx, *pg*), and gave some account of that sclerite in the œsophagus, which to my mind is so suggestive in its bearing on the phylogeny of the group. An abstract of Grosse's paper, by Prof. Geo. Macloskie, was published in the "American Naturalist," vol. xx, p. 340.

The following detailed accounts, with accompanying figures, of the mouth-parts of *Ancistrona gigas* P., *Læmobothirium* sp., *Eurymetopus taurus* N., and *Goniodes cervinicornis* G., are based on dissections made in my laboratory by Mr. R. E. Snodgrass, and are mostly in the words of his notes. The drawings also were made by Mr. Snodgrass.

---

* Denny, Henry. Monographia Anoplurorum Brittanniæ, 1842, London.

† Giebel, Christoph. Insecta Epizoa, 1874, Leipzig.

‡ Piaget, E. Les Pédiculines, 1880; Supplement, 1885, Leyden.

§ Taschenberg, O. Die Mallophagen, 1882, Halle.

‖ Grosse, Franz. l. c.

THE MOUTH-PARTS OF ANCISTRONA GIGAS.

(Plate lx, figs. 6–12.)

In this form the full number of mouth-parts is present, and all are complete except the maxillæ, these lacking palpi and distinct sclerites. The labium is well developed and much longer than wide. It extends along nearly the whole length of the ventral surface of the head, the anterior border being situated far forward, leaving only the tips of the mandibles visible. When the palpi are parallel to the plane of the head their extremities project a little beyond the anterior lateral margin.

The *labium* (plate lx, fig. 7) consists of three distinct parts, the ligula, mentum and submentum together with prominent palpi. The mentum is the largest sclerite and bears the four-jointed palpi. It is somewhat wider than long, and is incompletely divided into three lobes, one placed medially and the others on each side of this. The median portion has the anterior border straight or a little concave, and articulates with the ligula. Each lateral lobe is narrow and projects anteriorly beyond the median portion which is much wider. Each bears distally a palpus. The latter is composed of four short joints of about equal length, but the second is rather thicker than the others. The lateral outlines of the mentum are roundly convex. The median lobe forms, in part, a concavity on the surface of the labium, but its posterior part forms a wide elevation, continues externally with the elevated lateral lobes, and is sharply marked off from the posterior part of the sunken portion. This elevated posterior border bears a pair of large, strongly chitinized, backward-projecting structures, each being a sort of fork, with two prongs articulated at their bases (plate lx, fig. 7, *pr.*). One of the prongs in each fork lies dorsal of and a little within the other. This dorsal prong is attached by its base to the mentum near the hind margin of the latter. From the posterior border of the mentum a deeply emarginated fold extends backward between the two forks, and is attached to the inner edge of the dorsal prong of each. In the young the emargination is much less, the fold being merely roundly concave posteriorly. In this stage it is attached for its full length along the median line to the submentum. In each fork the dorsal prong is rather flattened dorsoventrally; its outer edge is rounded inward proximally and outward distally, while the inner edge presents the same outlines, only in different order, so that the whole is doubly bent, first inwardly and then outwardly. The curvatures, however, are only slight, and the distal one is more marked than the other. The prong is much wider at its base than elsewhere, and tapers off very much distally. It ends by a triangular expansion, having one side of the triangle facing posteriorly and inwardly. At the base is an oval fossa, and in this the outer prong is articulated so as to allow of considerable movement. At the anterior outer corner of each fossa a large strong hair arises and extends outward and backward, being two-thirds or three-fourths the length of the fork. The ventral prong is more cylindrical than the other and tapers but little. It is almost straight, or slightly curved inwardly near the middle. Its base, however, curves dorsally, to be articulated with the other piece, as just described. It ends by a bluntly rounded termination which is very slightly expanded. Its dorsal surface is covered by numerous fine, closely arranged, rounded ridges. Proximally these lie almost longitudinal, but they gradually become more transverse, so that the terminal ones form an angle of about thirty degrees with a transverse line through their inner ends. The ridges meet each other along the median line of the prong at an increasing angle from in front backwards. The forks are less chitinized in young specimens, but very pale colored ones have them comparatively strongly chitinous, so that they appear very dark, while the rest of the outer parts are white.

The ligula is a short sclerite, divided into glossæ and paraglossæ. The glossæ are two rounded lobes, with a shallow concavity between them. They bear a few short hairs. External to the glossæ are the paraglossæ which are also two small simple lobes. They are separated from the glossæ a little more deeply than the latter are from each other, and like them are covered by a few small hairs.

The submentum is a simple sclerite back of the mentum, and mostly concealed by the forks and connecting fold from the latter.

The *maxillæ* (plate lx, fig. 8) are very weak, unchitinized structures, lying entirely within the mouth cavity, and concealed by the other mouth-parts on account of their very reduced size. Each consists of a basal undivided portion, somewhat roughly triangular in outline, and of two distal, soft fleshy lobes. The outer lobe is the larger of the two, and its inner edge lies ventral to the outer edge of the smaller lobe. Both lobes are longer than wide. There are no hooks or points of any nature, and no hard chitinous parts. The lobes appear to be galea and lacinia, but in the adult form there is nothing to show that these are what they are, and that they are not simply the result of a secondary division of a simple fleshy lobe, which is the common form of maxilla in the group. The basal portion shows no indication of being composed of two sclerites. The rudimentary condition and soft weak structure of the maxillæ apparently must render them of little or no function.

The *mandibles* (plate lx, figs. 6, 9 and 10) are large and strongly chitinized structures, and evidently perform an important part in the feeding habits of the insect. They are somewhat roughly triangular in profile, having each two points anteriorly and internally, opposing those of the mandible of the opposite side. They lie in a plane parallel to the head. The left one has its anterior surface smooth and a little convex. From the inner edge, a little back of the anterior angle, there projects inwardly and forward a short rounded process. Anterior to this and ventral to it the sharply terminated anterior angle of the mandible forms the second point or tooth. This one is very sharp compared with the other. The ventral surface is concave ventral to the posterior tooth and behind the anterior one. The latter is continuous down the ventral surface as a high wide ridge along the outer side. The posterior part of this surface is also elevated, and at the inner posterior angle is continued inward as a long and somewhat slender projection into the mouth cavity; this tapers distally, but terminates bluntly. At its base are two teeth projecting forward into the concavity on the ventral surface of the mandible just described.

The mandible is articulated to the head by a condyle and a facet. The condyle is on the posterior ventral edge, near, but some distance internal, to the outer posterior angle of the mandible. It is a rounded knot projecting backward. The facet is situated on the dorsal surface near the same angle of the mandible as the condyle. It, however, is not situated on the posterior edge, but somewhat further forward on the dorsal surface; but it lies in the same anteroposterior dorsoventral plane as the condyle. It faces posteriorly and outward, being situated on an elevation, and the cavity is rather shallow. The right mandible is a little smaller than the left but is otherwise very similar to it. There are the same two teeth, but the posterior one is a little thicker than on the left side. The concavity on the ventral side is not so extensive, and the projection from the inner posterior angle is shorter and thicker. The articulatory condyle is similar in position, but is perhaps a little larger. The facet, however, is relatively more external. In each mandible there is a considerable extent beyond a line drawn from the condyle to the facet, but this is much shorter than that in the opposite direction; i. e., inwardly. Each mandible is supported by two large chitinous processes (plate lx, fig. 9, *d. ch. r.* and *v. ch. r.)*, arising from a common thick base which is attached to both the ventral and the dorsal wall of the head. One of these processes lies ventral to the other, and, in the case of the right mandible, a little internal to it. The ventral projection bears terminally a socket and the dorsal one a condyle; these articulate respectively with the condyle and facet of the mandible. The mandible is thus supported on an axis above which is all its weight; and further, the greater part of the latter falls on the inner side of the axis when the mandibles are in the resting position. To the posterior edge of the mandible, near the inner angle but still some distance from it, is attached, movably, a slender chitinous rod. This rod passes posteriorly outward and dorsally, and is attached to the dorsal wall of the head by bundles of muscle-fibers. To the outermost projecting angle of the mandible are attached directly other but much smaller muscles. These have their insertion also on the wall of the head, back of the mandible. These various inequalities noticed on the two sides of the mandibular axes make the strength of the closure of the mandibles much greater than that of the opening.

There are several internal mouth structures rather curious in form, and whose functions are not definitely apparent, although they probably serve in some way for rasping or comminuting the food, or perhaps for holding it.

In the ventral wall of the pharynx is imbedded a chitinous rod or shaft, bearing two prongs at each end (plate lx, fig. 11, and fig. 6, *hy.*). The shaft is rather long and slender, with a swelling posterior to the middle. The posterior prongs are curved outward and backward, and also a little upward around the œsophagus. Their bases are very wide but they soon become narrower. Terminally each is somewhat expanded and ends bluntly. The anterior half of the wide basal portions is much thinner than the rest, and the shaft appears between the two as a wide elevated ridge, continuous with the posterior thickened borders. A large oval foramen, having its long axis extending from within outwardly and posteriorly, is situated between the thin part, the thickened shaft, and the posterior elevated margin. The anterior fork projects into the mouth, dorsal to the anterior end of the labium, in the position of a hypopharynx. The prongs of this bifurcation are much smaller than those of the other and project outward and forward. The entire length of the structure in a specimen measured is .52 mm. The part projecting is about a fifth of the whole. All but this latter part is imbedded in the ventral wall of the pharynx and is not visible from above. It is evident that it must be developed from an invaginated portion of the cuticle which became strongly chitinized and constricted off from that lining the mouth. The two anterior prongs have on their anterior edges each a padlike, soft, unchitinized structure. Each pad is distally surmounted on the dorsal surface by a large cluster of rather long, thick, curved processes, radiating from a common center and curving upwards.

All have their concave borders facing one another and the center from which they spring. Along the convex surface of each is a fringe of cilia inclined distally. The rest of the pad is covered by short, thick projections, lying with their long axes parallel to the surface and curving over to the dorsal side, where they become scale-like in form. Between this hypopharynx and the labium is a fold of membrane from which project the anterior ends of two other structures. There are two chitinous rods (plate lx, figs. 6, *fk*, and 12) whose anterior forked ends project through this fold and lie beneath and a little external to the hypopharynx. They may be exposed by removing the labium. Each lies ventral to all the other organs in the head. Posteriorly they diverge from each other and pass backward, ventral to the lower edge of the tentorium, and are attached to the ventral wall of the head by muscles. They are very slender and delicate on account of their thinness and being not very strongly chitinized. Anteriorly each is rather expanded and flattened dorsoventrally, but posteriorly becomes narrower and more cylindrical. The outer prong of the anterior bifurcation is wide and thin, the other is longer, narrower, a little curved outwardly, and rather more chitinous than any other part of the whole rod. The bifid part projects out of the fold as described, but very little if any of the shaft. The cuticle covering the fold is continuous with that over the pads on the fork of the hypopharynx, and is covered by small sharp-pointed papillæ, having enlarged bases, and projecting forward.

THE MOUTH-PARTS OF LÆMOBOTHRIUM SP.

(Plate lxi, figs. 1-5.)

The *labium* of *Læmobothrium* sp. (plate lxi, figs. 1 and 4) consists of submentum, mentum, palpi, and ligula. The labium as a whole occupies two-thirds of the length of the ventral surface of the head. Its anterior border lies in front of the bases of the antennæ, and extends also considerably farther forward than the bases of the mandibles; hence the latter are almost concealed by the labium.

The submentum (plate lxi, fig. 4, *sm.*) is a transversely narrowed sclerite very convexly rounded posteriorly, and slightly concavely rounded laterally where it joins the temporal sclerites. The anterior border is more decidedly concave and articulates with the convex posterior border of the mentum. The submentum is a little wider than half its length, and on the whole is somewhat narrowly shield-shaped. In front of the submentum is the mentum (plate lxi, fig. 4, *m*). This sclerite is wider than long and is somewhat oval in outline, with the long axis transverse; the latter is a little in front of the middle point. The lateral and posterior borders are very convex, and the sclerite may also be regarded as being an isosceles triangle with the angles very much rounded, and the apex pointing backward. Laterally there are two short thick, anterior prolongations, *pf*, one on each side. These bear the short four-jointed labial palpi. Each segment of the palpus is rather short and cylindrical and bears a few hairs. The terminal one is shorter than the others and forms a rounded termination to the palpus. The ventral surface of the mentum is produced downward into a large saccular or pouchlike distention which is almost as wide and long through its greatest diameters as the mentum itself. Where the pouch joins the mentum, however, it is narrower than it is a short distance below; it therefore expands a little ventral to its dorsal border. In a mounted specimen the pouch may be pressed down flat against the rest of the labium, and then its anterior border appears to be a fold of membrane extending over the ventral surface of the ligula from the anterior edge of the mentum. Within this pouch are two large glands (plate lxi, fig. 5) lying side by side, one on each side of the median line. They are narrower anteriorly where they open into the mouth cavity near the anterior edge of the labium. Posteriorly they become enlarged and turn outward.

The ligula is composed of glossæ and paraglossæ. The glossæ are flattened lobes, one on each side of the middle line, and separated from each other for about two-thirds their length. Each is about as wide as long, and the anterior border slopes slightly outward from within. The outer borders are straight. The paraglossæ lie just exterior to the glossæ. Each is conical with the end truncated, and is a little longer than the glossæ.

The *maxillæ* (plate lxi, figs. 1, *mx*, and 3) are simple lobes expanded distally but narrow at the base. Each projects inwardly and forward, and lies just back of the mandibles of the same side. The ends are exposed in front of the labium. The length is much greater than the greatest width, and the borders are all convex except the posterior two-thirds of the outer, which is a little concave. The anterior and inner edges form a continuous curve, and along these borders the maxilla is strengthened by a chitinous thickening. Along the anterior margin and the anterior part of the inner, is a series of chitinous teeth which are not very sharp and have their points mostly directed inwardly. Each is a continuation of a plication, or thickening, on the maxilla outside the chitinous marginal thickening and perpendicular to it, the latter lying close to the edge, just back of the teeth. Near the base of the maxilla on the inner side is attached a large muscle, as large as the maxilla itself. This large muscle and the strong teeth seem to indicate that the maxilla is not functionless, but that it plays some part in the mastication of the food.

The *mandibles* (plate lxi, fig. 2) are the same in general shape and position as those of *Ancistrona gigas*. Those of the two forms present corresponding processes, and in each they lie in a plane parallel with the head. They are in both triangular in general outline viewed dorsoventrally.

The right mandible of *Læmobothrium* has at its anterior inner corner a large, strongly chitinized tooth, which is a continuation inward and forward from the ventral surface of a strong anterior thickening of the mandible. Posterior to this is a second tooth, just as in *Ancistrona*, continuous with the dorsal surface. This, however, instead of being regularly rounded is in *Læmobothrium* very wide, especially at the base, and is of the form of a truncated cone. The inner, or free end, is roughened by several short blunt cusps. This tooth, however, very evidently is the same thing as the posterior tooth of *Ancistrona;* the positions on the mandibles are identical. From the inner posterior angle is a thick blunted process extending inward. It is rather short and terminally rounded. This process is present also in *Ancistrona gigas*. The outer posterior angle is truncated, and at its inner corner, projecting from the ventral surface, is an articulating condyle. This is some distance from the outer corner, and to the latter is attached the extensor muscle. The condyle projects backward and a little outward, and fits into a socket of the head. Dorsal to this on the head is a condyle which articulates with a facet on the dorsal side of the mandible. This facet is more external than the condyle of the mandible, and is also farther forward. In all these points the mandible is extremely similar to the corresponding one of *Ancistrona*. The retractor muscle is attached directly near the inner posterior angle.

The left mandible is in general similar to the right, and agrees with the corresponding mandible of *Ancistrona* in the same way as the right one does, although the two are rather less alike than those of *Ancistrona gigas*.

The posterior tooth of the left mandible is continuous from the dorsal surface, but is very small compared with the anterior one, and is sharp-pointed compared with the corresponding tooth on the right side. The anterior tooth is much the same as that on the right side, or is perhaps a little smaller. Back of it is a depression on the inner part of the ventral surface; this is bounded behind by an elevation which is continuous inwardly as a slender projection from the ventral surface, just as in the case of *Ancistrona gigas*. This process is thick at its base but tapers distally to the rounded termination. Its anterior border is convex, but on the distal half of the posterior margin is a rather deep, rounded concavity. To the outer angle of the base is attached the extensor muscle. This is rather large on each side of the head. Internal to the attachment of the extensor muscle is the articulating condyle, and dorsal to the latter the rather large facet. These articulate as on the other side, with a facet and condyle, respectively, of the ventral aspect of the head.

THE MOUTH-PARTS OF EURYMETOPUS TAURUS.

(Plate lxii, figs. 1-8.)

There are many striking differences between the mouth-parts of this form and those of either *Ancistrona* or *Læmobothrium*. The dissimilarity is most noticeable in the labiums. *Ancistrona* and *Læmobothrium* both belong to the suborder Amblycera, while *Eurymetopus* and the next form to be described, *Goniodes*, belong to the suborder Ischnocera, and the differences presented by these four genera are typical for the two groups.

In *Eurymetopus taurus* the *labium* (plate lxii, figs. 1 and 6) is reduced in size, and very much crowded back on the posterior aspect of the head. Instead of covering over the mandibles ventrally, it leaves them entirely exposed, its anterior border reaching only about as far forward as their posterior articulations.

On the posterior half of the median ventral surface of the head is a large unchitinized space. This is bounded laterally by the temples, posteriorly by a narrow, gular sclerite, presenting an obtusely angulated, convex, anterior border, and anteriorly in appearance by the mandibles, although it is really not bounded at all in front. The area is somewhat heart-shaped, having the apex forward, for the boundaries formed by the temples are convergent forward.

The membranous labium stretches across the posterior half of this space, while the part in front of the labium forms the mouth-opening. The labium is composed of the full number of sclerites, and of these the submentum is the largest. It is much wider than long; is unchitinized and membranous, and is attached all around, except in front, to the edges of the space just described. Its lateral edges are convex and rounded, while the posterior border is angularly emarginated to receive the convex margin of the gula. Its posterior angles are much rounded. Anteriorly it presents a concave border of which the lateral portions are free, but the median part bears the mentum. The submentum, on account of its anterior and posterior concavities, is much constricted in the middle.

The mentum is a comparatively narrow, tranversely elongated, unchitinized sclerite, attached posteriorly to the submentum, but having its lateral borders free. The anterior outer angles are rounded. The median portion of the anterior border bears the glossæ and paraglossæ. These are not separated by any suture from the mentum, and hence there is no distinct ligular sclerite. The glossæ are two small oval lobes situated on each side of the median line and close to each other, being only slightly separated. Each bears four or five large, strong hairs situated on small basal segments. External to each glossa is a rather deep fossa in the mentum. In these fossæ are situated the paraglossæ. These are cylindrical structures having the outer ends somewhat enlarged, and bearing six or seven large, strong, two-jointed hairs like those on the glossæ. The paraglossæ are rather strongly chitinized compared with the rest of the labium; they appear dark while the other parts are white. Each is directed outward, forward, and downward. With the exception of the hairs on the glossæ and paraglossæ there are almost none on the labium. Two small ones situated on basal joints occur on the mentum, one just back of each glossa. The oddly shaped, cylindrical paraglossæ, having the stiff, thick, two-jointed hairs on the flattened outer ends, are very characteristic of the suborder Ischnocera. In undetached labiums there often appears to be a narrow sclerite between the sclerites which have been called mentum and submentum, but in the mounted specimen this does not appear.

The *maxillæ* (plate lxii, fig. 4) are simple, fleshy, unchitinized lobes attached to the lateral parts of the mouth-cavity, back of the mandibles. They show no indication of division into different sclerites. Near their bases they are somewhat thickened; the distal ends are weak and almost membranous, in mounted specimens they generally appear twisted and distorted. On account of the position of the labium the maxillæ are mostly exposed, only the bases being concealed. Each projects forward and inward.

The *mandibles* (plate lxii, figs 1 and 5) present a very strange appearance, both on account of their shape and their position. They are large, heavy, and strongly chitinized, and very remarkably different from those of *Ancistrona* and *Læmobothrium* in the way they are attached to the head. In these two genera the mandibles lie in a plane parallel to the head, and move in this plane. In order that this may be so, their articulating surfaces are in the same or nearly the same dorso-ventral line. In *Eurymetopus taurus* there are two articulating surfaces as before, but the mandibles move in a plane which forms a large angle with the horizontal plane of the head. To accommodate this action the articulating surfaces lie one in front of the other. The plane of the mandible is, however, not at right angles to that of the head, and consequently the anterior articulation is a little dorsal to the posterior one. In the next form to be described, *Goniodes cervinicornis*, the mandibles are almost or quite at right angles to the head, thus presenting an advance in this respect beyond *Eurymetopus*. In either of these two genera the mandibles may be regarded as being the same, typically, as in the Amblycera; but that each has been revolved on an axis passing from the tip of the inner basal process to the articulating condyle, until the anterior margin becomes the ventral margin. All the apparent differences may be reconciled by this view. In accordance with it the articulating surfaces lie as they should. Further, the mandibles being as in the other genera, two-toothed, the posterior rounded tooth of *Ancistrona*, arising from the inner dorsal margin, lies in this form on the anterior inner aspect, in front of, and dorsal to the larger tooth.

The left mandible has also the long slender process at the inner part of the base, as in *Ancistrona* and *Læmobothrium;* but, as would be expected, this arises from the dorsal aspect of the base. Since, however, in *Eurymetopus* it is very long and slender, it is bent backwards so as to lie parallel with the head. In *Goniodes cervinicornis*, however, it is shorter and projects inwardly.

The mandibles of *Eurymetopus taurus* are entirely exposed on the ventral surface of the head, not even their bases being covered by the labium. They are thick and have a clumsy appearance. The anterior articulating surface is a large facet situated at the anterior outer angle of the mandibles, on the dorsal surface. A rounded process projects over it from below. The posterior outer part of the mandible, bearing the condyle by which it is articulated posteriorly, is greatly prolonged backward, forming a long process bearing the condyle at the extremity. The latter fits into a chitinous socket on the ventral surface of the head. Some distance in front of this is a condyle which fits into the facet of the mandible. The process above referred to, arising from the inner dorsal aspect of the left mandible, curves inwardly and posteriorly. It is very wide at its base but rapidly diminishes distally, and ends by a slightly enlarged extremity, free in the mouth cavity. The ventral tooth of each mandible is large and thick, and bluntly pointed. The dorsal tooth is shorter than the other, not so thick, and has a rounded termination. Its anterior border is just visible from the ventral side of the head, in front of that of the ventral tooth.

In *Eurymetopus* and in a large number of other genera of the Mallophaga there occurs a very curious pharyngeal sclerite with accessory structures, within the cavity of the head. It is not intended here to explain the origin or function of these, but merely to describe them.

The sclerite referred to is a thick, strongly chitinous structure situated in the ventral wall of the pharynx, and is probably a greatly modified portion of its chitinous cuticle. In a mounted specimen it is plainly visible through the head from either the upper or the lower side. Lying ventral to the sclerite are two structures which appear to be glands, and are connected with it by a duct. All three of these structures are visible through the head of cleared and mounted specimens, and lie just back of the anterior edge of the labium.

This *œsophageal sclerite* (plate lxii, figs. 1, 2, 3 and 7) is in general form cup-shaped, having the hollow part turned upward and forming a depression in the floor of the pharynx, since its interior is simply a part of the pharyngeal cavity. The ventral surface is very convex, being almost hemispherical. The anterior end is truncated, but from each of the two anterior angles thus formed there projects forward, outward, and dorsally, a large dorso-ventro-laterally flattened process, which lies in the lateral wall of the pharynx, the two partly surrounding the cavity of the latter. Each of these processes is expanded distally, and sends a long, rounded, and bluntly terminated projection backwards. These latter processes lie parallel with and a little external to the lateral margins of the body of the sclerite, their outer edges being visible from the ventral side. Posteriorly there is a thick, rounded, median process which projects backward from near the dorsal edge of the sclerite, but still some distance below it, so that it is free from and not imbedded within the wall of the pharynx.

The sclerite, viewed ventrally, is somewhat shield-shaped in profile. The body is almost semicircular, with a small segment taken off in front by the anterior truncation referred to. Posteriorly there projects the median rounded process, and anteriorly on each side the anterior lateral processes. The latter give to the anterior profile an emarginated appearance. In the middle there is a longitudinal light colored area, due to the cavity on the dorsal side, the floor of which, being thinner than the other parts, transmits more light in mounted specimens. This area is expanded near the front, contracted from side to side posteriorly, and rounded before and behind. Along the median line there is a narrow linear area still lighter in color, due to a groove in the bottom of the dorsal hollow.

The dorsal surface of the sclerite is, as already described, excavated, and is doubly so, there being one cavity situated within another. The upper of these is a shallow depression, having its edges rather oval in outline. In front it extends very near the anterior borders of the sclerite, but on the sides the edges of the cavity and those of the sclerite are considerably separated; and that portion of the dorsal surface between these two is rounded outwardly and ventrally. This space is narrowed again posteriorly, but not so much as in front. The inner cavity is situated in the floor of the other. It is much deeper, and its walls are steep, meeting the interrupted walls of the other at a considerable angle. It is this deeper cavity that forms the light colored area noticeable on the sclerite when viewed from the ventral side by means of transmitted light. It is much longer than broad, and its widest diameter is in front of the middle. Anterior to this the dorsal edges form a rounded outline, but back of it they are a little concave and approach each other posteriorly. The posterior end is narrow and rounded. The walls of the cavity are concave, steeper in front and behind than elsewhere. The bottom slopes a little downward posteriorly, so that the cavity is deepest behind. Running longitudinally along the bottom is a narrow groove; this begins in front at the bottom of the anterior wall, and extends backwards from an aperture which is the opening of a duct into the sclerite.

To the sides of the shallower cavity are attached two large, laterally compressed, chitinous, pyramidal structures, one on each side, whose ventral surfaces are not quite so divergent as the walls of the cavity to which they are attached, or perhaps better, from which they arise. The bases of these are very wide, but dorsally they become rapidly narrowed and pass upwards around the œsophagus, or pharynx, as two chitinous bands. Their dorsal ends are attached by large muscles to the dorsal wall of the head.

The sclerite is about as wide as long, or sometimes a little longer. The dimensions of one specimen measured are as follows: Length of the body, .097 mm.; width, .108 mm.; length of posterior projections, .02 mm.; distance which anterior processes extend in front of anterior border of the main part or body, .0227 mm.

The gland-like structures (plate lxii, figs. 1, 7 and 8) before referred to, lie ventral to the sclerite, and the inner halves overlap its outer portions (fig. 7). Their outer edges also lie a little dorsal to their inner edges, so that they extend slightly around the outer margins of the sclerite. Each is an oval structure, having the long diameter extending from within outwards and backwards. The ventral surface is convex, and the dorsal surface concave, while the whole is very much flattened dorsoventrally. Each is invested in a thin chitinous envelope, and is seated upon the ventral anterior surface of a chitinous pedicle which is expanded where it receives the gland. The expanded portion of the pedicle is thin and convex ventrally, so as to fit the dorsal concavity of the gland; and the middle of its shallow dorsal concavity lies below and external to the outer edge of the sclerite. Back of the glands the pedicle extends backward and outward, but not so much in the latter direction as the long axis of the gland, so that the two form an obtuse angle inwardly. The part of the pedicle not having the gland attached is about as long as the other part, and it is somewhat more chitinous. It tapers backward, but ends in a foot-shaped expansion, with the toe turned outward. To this is attached a large, wide muscle which extends backward to its origin in the posterior part of the head cavity. At the posterior end of the gland, on the ventral surface, a duct arises which passes forward, attached closely to the gland, to its anterior end; here it leaves the gland and continues forward, but soon turns inwardly and dorsally, and then posteriorly, meeting and fusing with the duct from the gland of the other side. This common duct then runs backward to the sclerite, which it enters as already described. The relative positions of the glands and sclerite vary somewhat, since they are evidently movable structures, judging from the attached muscles, and hence, also, the duct varies in position; but all such changes are slight. The free portion of the duct consists of an inner chitinous tube continuous with that soldered to the glands, but in addition to this there is an outer portion composed of a series of closely set, chitinous rings, surrounding the tube. Each gland is about as wide as the sclerite, but is considerably longer.

THE MOUTH-PARTS OF GONIODES CERVINICORNIS.

(Plate lxi, figs. 6–9.)

In *Goniodes cervinicornis* as in *Eurymetopus taurus* the mouth-parts are crowded far back on the ventral surface of the head, so that the bases of the mandibles lie posterior to the bases of the antennæ, instead of in front of them, as in most of the Amblycera.

The *labium* (plate lxi, fig. 7) has its anterior border between the bases of the antennæ, and hence it is very much shortened from before, back. The part which seems to have suffered most in the crowding is the mentum. It is narrow and not distinctly separated from the ligula, and is farther aborted by having lost its palpi. This condition is true not only in the genera *Eurymetopus* and *Goniodes*, but holds for the Ischnocera generally.

The main sclerite of the labium is the submentum. This is a large unchitinized sclerite, having a straight posterior border and a very concave anterior border. The sides present an obtusely angulated, convex margin. The anterior border is so deeply and roundly concave that it forms almost a semicircle. Its most posterior part is as far back as the middle of the lateral edge of the sclerite; hence there is a narrow portion projecting forward on each side. These reach as far anteriorly as a line joining the middle of the bases of the antennæ. The rest of the labium is situated in the concavity of the anterior part of the submentum. It consists of the fused mentum and ligula (plate lxi, fig. 7), and is divided into three lobes, two lateral and one median. The median lobe is almost square, and has its anterior border slightly emarginated and the anterior outer angles projecting a little. This lobe is thus composed of the glossæ, which are separated only by the anterior emargination. The lateral lobes are rounded and bear the cylindrical paraglossæ. These are almost identical with the paraglossæ of *Eurymetopus*, being also more strongly chitinized than the rest of the labium, and bearing on their slightly expanded ends a few strong hairs with basal segments. They project ventrally and a little inward and forward, the distal ends being nearly always seen first on focussing down on a specimen toward the ventral surface.

Back of the submentum is a narrow gular sclerite continuous across the median line from the lateral portions of the head.

The *maxillæ* (plate lxi, fig. 6) are soft unchitinized structures lying within the mouth cavity. Each is divided into three lobes: one basal, another terminal, and the other between these two. By the basal lobe the maxilla is attached to the wall of the head, and it projects inward into the mouth cavity. It is irregularly round in outline and is entirely unchitinized. The middle lobe is of about the same size as the first, and is joined to the latter by a constricted neck. This lobe projects forward and inward within the cavity of the mouth. The third lobe is the largest and is oval in profile, with the long axis at right angles to that of the middle lobe, to which it is attached by a narrow neck at its inner and posterior aspect. This lobe, as well as the middle one, is entirely unchitinized. It projects out of the mouth cavity, and lies close behind the mandible of the same side.

The *mandibles* (plate lxi, figs. 8 and 9) are large and strong; their bases lie some distance back of those of the antennæ; they hang downward from the head in a plane almost perpendicular to it, but inclined very slightly forward; their tips meet in the middle line, so that they form an arch over or ventral to the mouth-opening. The anterior lateral projections of the submentum extend forward beyond the bases of the mandibles, and the glossæ and paraglossæ lie just back of their posterior margins. Hence the mentum, ligula and mandibles are all enclosed in the anterior semicircular border of the submentum.

The right mandible is triangular in dorsoventral section. The ventral part is thickened and prolonged inwardly at the inner ventral angle, forming two large thick, bluntly pointed teeth. These are separated from each other only by a slight emargination, and they lie one anterior to the other. The anterior of these probably corresponds with the dorsal tooth of the mandible of *Ancistrona gigas;* if so, it has changed its position so that its tip is as far forward as that of the posterior tooth, and these two have become fused into a single process. The anterior tooth, however, does not reach quite as far inwardly as the posterior one, and is also a little dorsal to it. Both of these positions correspond with those of the dorsal tooth of *Ancistrona gigas* and *Læmobothrium.* A large thick process projects inwardly from the inner dorsal angle. This very evidently corresponds with the extremely similar process from the posterior inner angle of the right mandible of *Ancistrona*, and with the less similar but certainly homologous process of *Læmobothrium.* This projection is the inner end of a posterior thickening of the mandible which bears near the outer angle of the base, on the posterior aspect, the articulating condyle. This projects dorsally, and fits into a socket on the ventral side of the head. On the anterior side of the mandible, somewhat more ventral than the condyle, is the articulating facet into which fits a condyle from the ventral surface of the head. The facet presents the peculiarity of having no inner wall, and is separated only by a constriction from a large cavity in the anterior thickened part of the mandible. This cavity is elongated in a line extending from the facet to the two teeth of the mandible. The posterior wall of the cavity is very thin.

Attached to the dorsal border of the inner angle of the mandible is a large thin chitinous plate (plate lxi, fig. 9, *ch. pls.*). This plate is thickened proximally and appears here darker than the rest. This part is also narrow, but distally the plate expands and becomes very thin and transparent. The distal border is not definite, being very thin and generally irregularly broken away. Attached to this plate are the retractor muscles of the mandible. The plate and muscles extend dorsally and very slightly backward from the mandible, since they lie in the same plane as the latter. From the outer posterior angle of the mandible there extends dorsally and outward a slender, very thin, chitinous structure, which bears the extensor muscles of the mandible. These two sets of muscles are attached to the dorsal wall of the head. The left mandible is very similar to the right. The two teeth are more separated and are sharper. The process projecting inwardly from the base is slenderer and longer than on the right mandible. It arises a little ventral to the dorsal inner angle, and is slightly rounded ventrally, while the tip is again turned a little in the same direction. The muscles are attached in the same way as in the case of the right mandible. To the dorsal inner border of each mandible there is attached, also, internal to the attachment of the plate, a fringe of large muscle fibers; these appear to be a second set of retractor muscles.

In *Goniodes cervinicornis* there is a pharyngeal sclerite and pair of glands which are in every way similar to those of *Eurymetopus taurus*. Besides these, however, there are two forked rods projecting into the mouth cavity, as in the case of *Ancistrona gigas*. These rods are extremely slender and difficult to dissect, but they lie just dorsal to the labium, and pass forward beneath the œsophagus, and ventral to the glands connected with the pharyngeal sclerite. Only the bifid tips project into the mouth. Near the anterior end muscle fibres are inserted which pass forward and downward to their origin on the dorsal side of the labium. These evidently serve to draw the rods forward. Those of *Ancistrona gigas*, which is enormous amongst Mallophaga, are almost invisible to the naked eye, being weakly chitinized, and only .5 mm. long by .05 broad at the widest place. Only one specimen of the species of *Læmobothrium* described was had for dissection, and the rods may have been present but overlooked. Also it cannot be stated that they do not occur in *Eurymetopus taurus*. It is to be noticed that the genera *Ancistrona* and *Goniodes* belong to the two different subgroups of the Mallophaga.

RESUMÉ.

From these detailed accounts of the mouth-parts of four genera of Mallophaga, equally divided between the two principal groups of the order, we may confidently make a summary statement of the condition of the mouth structures of the Mallophaga.

The mouth-parts are confined to the ventral aspect of the much flattened head, the frontal margin of the head being formed by the greatly developed clypeus. The labrum is the foremost of these ventrally located mouth structures, and is well developed, serving for prehension, and in some cases as a disk or platelike sucker for attachment. It appears as a simple flap lying in front of, and, when at rest, partly over the mandibles.

The *mandibles* are large and strong, usually roughly triangular in profile, with at least one projecting sharp-pointed tooth, and one or two blunter teeth. Each mandible presents a characteristic facet and a condyle which articulate with two strong chitinous rami attached one to the ventral wall of the head and one to the dorsal wall. One ramus articulates by a condyle with the facet of the mandible, and the other by a facet with the condyle of the mandible. The mandibular muscles are exceptionally large. In the two genera of the suborder Amblycera, the mandibles lie in a plane parallel to the horizontal plane of the head, while in the two genera of the suborder Ischnocera, the mandibles project in a plane nearly or quite at right angles with the horizontal plane of the head. This remarkable difference is probably characteristic of the two main groups of the order. The mandibles, though varying somewhat in shape in the two groups, are essentially similar in general character and in manner of articulation; the articulations in the Amblycera lie in a dorso-ventral line, while in the Ischnocera they lie in a cephalo-caudal line; if, however, the Amblycerous mandibles be assumed to be rotated through 90°, so that the anterior aspect becomes directed ventrally, all of the apparent differences in position of features and manner of articulation between the mandibles of the two suborders become reconciled.

The *maxillæ* are greatly reduced, the basal and terminal sclerites so fused as to make it almost impossible to differentiate them, and the structure so feebly chitinized as to appear usually as a soft, small membranous lobe, lying almost wholly concealed within the mouth cavity. The inner border is sometimes chitinized, especially dis tally, and bears few to many small teeth. Sometimes the distal part of the maxilla is two-parted and these two parts may represent the galea and lacinia of the typical maxilla of the orthopterous type. The maxillary palpi are completely lost, there being no indication of them on any of the maxillæ examined.

The *labium* (see, in addition to figures previously referred to, plate lxiii, figs. 1, 2, 3, 5, and 6) shows some considerable variation in the two suborders. In the Amblycera it is a larger and more complete structure than in the Ischnocera. A distinct submentum, mentum, and ligula are always present, the ligula consisting of the two terminal lobes, glossa, and paraglossa of each constituent half of the labium, united at their bases. With the Amblycera conspicuous 4-segmented palpi rising from a basal segment-like palpifer are always present; while with the Ischnocera palpi are wanting. The ventral or other surface of the labium is in some forms (see *Ancistrona gigas)* provided with strong backward-projecting, pointed, sometimes bipartite processes, as with *Ancistrona gigas*, *Menopon tridens*, *Menopon robustum*, and others. These processes must subserve some holding on or clasping function.

A hypopharynx of elaborate structure was observed in *Ancistrona gigas*, but not in the other species dissected. Grosse refers to a delicate membranous fold of the ventral wall of the mouth, which in some forms projects beyond the ligula as the hypopharynx.

The "forks" observed in *Ancistrona* and in *Goniodes*—genera representing both suborders of Mallophaga—because of their similarity to the familiar "forks" of the Psocidæ are of exceptional interest, and have not heretofore been referred to in the literature of the Mallophagous mouth-parts. Most plainly discernible in *Ancistrona*, they are very small, fine, chitinous rods lying inside of the mouth above the labium, whose posterior ends are attached to the ventral wall of the head by muscles and whose anterior ends are shortly forked or bifurcated, and project through the lining of the ventral wall of the mouth, thus lying free and uncovered in the mouth cavity. Although not observed in the other two genera of Mallophaga dissected, it is not at all certain that they are not present, their extreme minuteness and delicacy making their discovery a matter of difficulty.

The œsophageal sclerite and glands are also structures of extreme interest from their probable identity with similar structures in the Psocidæ. They do not appear to be present in all the Mallophagous genera; but I have observed them in a majority of the genera, viz., *Docophorus*, *Nirmus*, *Lipeurus*, *Eurymetopus*, *Goniodes*, *Goniocotes*, *Giebelia*, *Oncophorus*, *Trichodectes*, *Colpocephalum*, and *Menopon;* also in Piaget's figures of *Akidoproctus* the sclerite is indicated. I have found the sclerite and glands absent in *Ancistrona*, *Nitzschia*, *Trinoton*, *Læmobothrium*, and *Physostomum*. It will be noted that the sclerite and glands are present in all Ischnocera examined, and in two of the Amblycerous genera; while in a number of other Amblycerous genera the structures are wanting. In *Læmobothrium*, where the sclerite is wanting, there is a pair of glands in the labium, evidently quite distinct from the œsophageal glands so far referred to. This œsophageal sclerite is a thickening of the chitinous intima of the pharynx, and appears as a bonnet-shaped sclerite lying on the ventral wall of the pharynx, with hollow part upward, with median groove closed behind, projecting processes at the anterior angles, and a pair of long slender "bonnet string" pieces, which project dorsally and pass on either side of the pharynx, or œsophagus, upward and around it, and attach by their ends to the dorsal wall of the head. Opening into the median groove from its ventral side is a small duct, which, followed to its source, is seen to come from the union of a pair of ducts, each one of which comes from an oval gland lying ventral to the sclerite, and fitting into a concavity on the anterior end of a weakly chitinized, pedicle-like structure, which projects backward and is attached by a foot-shaped expansion to a large, strong muscle. This sclerite, which I call the "œsophageal sclerite," shows distinctly through the dorsal and ventral walls of the head, so that it is usually a conspicuous feature in the markings of the head, appearing as a V- or U-shaped mark with thickened sides (see this mark in the various figures illustrating the systematic part of this paper). It is this sclerite which has been called in the monographs of the European writers the labium, and in my "New Mallophaga, I," I have constantly referred to it by the same name. It is this sclerite, too, undoubtedly, which is the subject of Melnikoff's references, in his embryological memoir, to a sucking apparatus. Grosse refers to this sclerite as the Schlundskelett, and describes it, briefly, in *Tetraopthalmus chilensis (= Menopon titan)* and *Goniodes dissimilis.* He found also a chitin thickening of the dorsal wall of the pharynx, immediately above the ventral sclerite.

The mouth-parts of the Mallophaga are distinctly fitted for biting; there are no mouth structures which lend any probability to the old theory that the Mallophaga took food by sucking. The peculiar pharyngeal structures, while not yet understood in point of function, are not at all of a character to suggest anything like a sucking function. Grosse comes to no definite conclusion regarding the function of these œsophageal sclerites, but he says: "Ich schliesse aus seinem Bau, dass derselbe nicht zum Saugen, sondern zur Ergreifung und zur Führung der aufgenommenen Federtheilchen dient." All of my observation, as far as it goes, tends to substantiate the belief, based on the structure of the mouth-parts, that the Mallophaga take all their food by biting. I have seen them biting off and eating the bits of feathers, and the crop content, which shows plainly through the skin of many specimens, is always composed of tiny bits of feathers.

COMPARISON WITH THE MOUTH-PARTS OF ALLIED INSECTS.

It should be of interest now to compare the mouth-parts of Mallophaga with the mouth-parts of those insects which have been placed in recent classifications nearest to the Mallophaga. Since the breaking down of Erichson's catch-all order, Pseudo-Neuroptera, the association of the Mallophaga, Termitidæ, Perlidæ, Embidæ, and Psocidæ, into the order Platyptera has been, until very recently, the usually accepted interpretation of the place of the Mallophaga among insects. The most recent classifications assign to the Perlids, Termites and Mallophaga ordinal rank. Undoubtedly the Mallophaga are to find their affinities among the members of the group Platyptera, and it is, therefore, with the mouth-parts of these insects that I shall attempt to compare the Mallophagous mouth-parts.

THE MOUTH-PARTS OF THE TERMITIDÆ AND THE PERLIDÆ.

(Plate lxiv, figs. 1-4.)

The Termitidæ (White Ants) present a racial or generalized condition of the simple Orthoptero-Neuropterous type of biting mouth-parts; free, strong, toothed mandibles, working meso-laterally; maxillæ (plate lxiv, fig. 2) well developed, with distinct cardo, stipes, palpifer, 4-segmented palpus, and both terminal lobes, the lacinia sharply two-pointed, and the outer hoodlike galea fleshy; labium (plate lxiv, fig. 1) with elongate elliptical submentum, mentum, 3-segmented palpi, and ligula showing in each half both glossa and paraglossa. The Termite species whose mouth-parts I figure to illustrate the general character of the Termite mouth structures is *Termopsis angusticollis*, a large form common in California.

The Perlidæ, as the Termitidæ, present the generalized biting type. In the adult Perlids, to be sure, the mouth-parts seem to be hardly functional, being reduced to a semimembranous condition, with some correlated changes in form. In the nymphs, however, the usual Orthopterous form is shown. I have figured the mouth structures of a nymph of *Perla* (plate lxiv, figs. 3 and 4). The mandibles of the adult are very small and but slightly chitinized.

THE MOUTH-PARTS OF THE PSOCIDÆ.

(Plate lxiv, figs. 5-11.)

The mouth-parts of the Psocidæ present a modified or specialized type of biting mouth-parts. They have been the subject of some study and some dispute, and perhaps are not yet fully understood. An especially confusing feature is the presence of the "forks," and characteristic and little understood organs are the paired "lingual glands" lying "within the tongue." The best paper on the Psocid mouth-parts is one by Edward Burgess,* in which special attention is given the forks and the lingual glands.

***Burgess, Edward.** The Anatomy of the Head, and the Structure of the Maxillæ in the Psocidæ. Proc. Bost. Soc. Nat. Hist., 1878, vol. xix, p. 291, pl. viii.

In the two subfamilies of the Psocidæ, the winged Psocinæ and the degraded, wingless Atropinæ, the attitude of the head varies from a hanging or vertical position in the Psocinæ to the nearly horizontal position of *Atropos*. With the change from vertical to horizontal position there goes a marked flattening of the head, so that the head of *Atropos* (plate lxiv, figs. 5 and 7) in its horizontally projected attitude, its flattened condition, and the limiting of the mouth-parts to the ventral aspect of the head, shows both in its relation to the body of the insect and in its own shape and condition, a great similarity to the horizontal, flattened head of the Mallophaga. The clypeus of *Atropos* is large, projecting far forward, and, as in the Mallophaga, forms the frontal margin of the head, the labrum lying on the ventral aspect of the head (plate lxiv, fig. 5). All the mouth-parts lie on the ventral aspect of the head (plate lxiv, fig. 5) The mandibles (plate lxiv, figs. 5, 6, and 8) are strong, toothed, and present distinct protruding condyles wholly similar in position and general character to those of the Mallophaga (see plates lx–lxiii). The maxillæ (plate lxiv, fig. 5) I do not understand, but there are no conspicuous terminal free lobes; there is a large basal part, and articulating with it the conspicuous 4-segmented palpi. The fork is long and slender, projecting farther forward than the front margins of the closed mandibles. The labium (plate lxiv, fig. 5) shows a large elongate submentum, a hexagonal mentum, and a ligula composed of two large, free outer lobes, and a median bilobed part composed of the inner lobes of the two sides partly coalesced. According to Burgess what I have called outer lobes are the reduced 1-segmented palpi. In addition the œsophageal sclerite (described hereafter for *Psocus* under the name "œsophageal bone") shows through the basal part of the labium.

Burgess has studied the mouth-parts of *Psocus* in detail, and for the sake of his accounts of the forks, and of the œsophageal sclerite and lingual glands, those structures so characteristic of the Psocidæ, and probably—certainly, in the case of œsophageal sclerite and lingual glands—quite as characteristic of the Mallophaga, I quote from his paper referred to, as follows:—

"The maxilla in *Psocus* is hinged to the head by a small obscure piece which is immovably soldered to a larger joint. The first piece represents, probably, the cardo of a typical maxilla (plate lxiv, fig. 10, *c)* and the second the stipes *(p)*. The stipes bears outwardly the 4-jointed maxillary palpus, while inwardly is hinged a thick, fleshy lobe, broad at the base, but soon contracting and curving inward. The tip is flat and has a broad, oval outline on the inside, and is strengthened by several imbedded chitinous rods and other pieces. This lobe, by its position and shape, is doubtless homologous with the ordinary outer maxillary lobe, or galea, of the other Orthoptera. Behind the lobe, that is between it and the tongue, lies the 'horny process' of Westwood's description, or 'fork,' as I shall call it. This is a slender, more or less curved chitinous rod with a forked bifid tip, and two or three times as long as the outer lobe (plate lxiv, figs. 9 and 10, *f)*. The distal portion of the fork, about one-third or less of its length, projects through the lining membrane of the mouth. At this point the fork is stoutest, and from it, it tapers to either end, the outer portion being stouter than the inner. The membrane where it is united with the fork is delicate and elastic, thus permitting the fork to be projected forward or drawn back at will. Within the head the fork is held in position by muscles inserted on its base, which unite it with the lobe and stipes of the maxilla, and by a ligament which runs backward to the top of the head. Of these muscles one is inserted on the base of the lobe; two others are inserted apparently within the stipes; by their contraction the fork is thrown forward out of the mouth, or moved about. The backward-running cord, which is double, is apparently neither muscular nor the tendon of a muscle, but simply an elastic ligament to draw the fork back, and probably the membrane pierced by the fork aids in the same movement. The fork is still further held in place by the flexor muscles of the stipes and lobe which pass behind it and serve to bind it down against the lobe.

"In the maxilla we have recognized cardo, stipes, and outer lobe, and one naturally asks if the fork is the homologue of the inner lobe of the typical maxilla, or an independent organ. At present I must incline to the latter view, although some may regard the absence of anything else to represent the inner lobe as sufficient evidence of their homology. But there is no articulation of any kind between the fork and the outer lobe, and the peculiarity of the muscular connections seem rather to favor the idea that the fork may represent an independent organ.

"The maxillæ and mandibles occupy the lower half of the large oral cavity which opens above into a thick-walled œsophagus. Below the opening of the œsophagus lies a bone which may be fancifully likened to a lady's bonnet upside down (plate lxiv, fig. 11 and *α. b.* fig. 9); the high front lies along the oral cavity at about half way up; two narrow extensions, representing the bonnet strings, run forward and upward, embracing the œsophagus. The great bundles of short muscles filling the large vaulted clypeus (plate lxiv, fig. 9) are attached to the ends of these strings, and by their contraction close the œsophagus. Just below the 'front' a fine duct opens which is the common duct of a pair of lingual glands, presently to be described. Just below this bone there is a double elevated ridge covered with short hairs (plate lxiv, fig. 11).

"The lower lip (plate lxiv, fig. 10) is composed of an oblong mentum *(m)* bearing a larger labium *(lb)* narrowed at the base, then expanding so as to have a bisinuate, almost S-shaped lateral outline; the lower edge bears two short, broad lobes, and two stumpy, one-jointed * palpi *(l.p.)*. The labium in profile (plate lxiv, fig. 9) is very thick, and the lower edge is divided into two narrow laminæ, while still a third lamina, well separated from the first two, forms the tongue (plate lxiv, fig. 9, *t*). Within the tongue lie a pair of peculiar organs which may be called the lingual glands (plate lxiv, figs. 9 and 10, *l.g.*); these can be seen through the semitransparent mentum and labium, as in plate lxiv, fig. 10, offering an irregular, obovate outline. A short duct from the lower end of each gland leads into a common duct *(l.d.)* which opens in the œsophageal bone as already described.

"The ducts curve over the lower end of the glands and run up their posterior surface, to which they are soldered nearly to the top. The line of the ducts, together with the lateral outlines, give the glands a three-cornered shape, somewhat like that of a butternut. A little triangular cap fits on the summit of each gland, and on it is inserted a suspensory muscle, the upper end of which is attached to the cranium (plate lxiv, figs. 9 and 10, *g.m.*). The specimens at my command have not been fresh enough to study the histology of these organs, but they seem to be composed of an outer sack, with a thin tough wall which

---

"* With Westwood I regard these pieces as true palpi, and not as a second pair of labial lobes."

is light yellow and has a slightly roughened or granular surface. The interior is filled with cells, and perhaps may be glandular. The excretory ducts are thick-walled and strengthened by circular threads, as is often the case with the salivary ducts of *insects."

Scudder in his note "on the structure of the head of *Atropos*," in "Psyche," 1877, vol. ii, p. 49, gives a different account of the fork, saying that "instead of forming a single, simple, rodlike process, this inner lobe [=fork] is three or four times as long as has been presumed, and is two-jointed, the apical point lying, when the organ is at rest, beside the basal joint, which is attached to the maxilla at the extreme base of the latter; the basal joint is directed backward and lies almost directly beneath the basal portion of the apical joint." Mr. Scudder believes that the fork is without any doubt homologous with the customary inner lobe, or lacinia of the maxilla. As will be noted in the foregoing quotation from Burgess, this author believes Scudder's account of the fork as a two-segmented organ to be erroneous, and he inclines to the belief that the fork is an independent organ, and not a part of the maxilla.

COMPARISON AND CONCLUSIONS.

But little special attention need be given to the comparison of the mouth-parts of the Mallophaga with those of the Termitidæ and Perlidæ. The last named families (or orders) show the simple Orthoptero-Neuropterous

---

"*The salivary ducts in most insects open by distinct apertures into the œsophagus; still, they unite into a common duct in many Diptera and some Orthoptera (see Siebold, Anat. Invert.). Siebold excepts only *Mantis* among the Orthoptera, but *Blatta*, *Termes* and the *Acrydians*, at least, must be added. The occurrence of salivary glands confined within the head is also unusual, but not without precedent."

type of mouth-parts, and offer besides this no special resemblances to the Mallophagous condition. There is no indication in the mouth-parts of the Termitidæ, wingless and specialized though the Termites are, of modifications in the direction of the Mallophagous mouth-parts. In fact, considering the food habits of the Termites and the specialization (by degradation) of their bodies, the mouth-parts show a surprising faithfulness to the simple usual Orthopterous type.

It is in the comparison of the Mallophagous mouth-parts with those of the Psocidæ that such interesting resemblances and parallel or homologous structures appear as to give basis for a belief in the near relationship of the two groups.

The comparison of the mouth-parts of the Mallophaga and the Psocidæ is not made here for the first time. In 1887 Dr. A. S. Packard read a paper before the American Philosophical Society entitled: "On the Systematic Position of the Mallophaga," in which he makes such a comparison. Dr. Packard based his paper on the studies of Melnikow and Grosse on the Mallophaga, and of Burgess on the Psocidæ, and on his (Packard's) own studies. In this paper attention is called to the general similarities shown in the two groups in the position of the mouth structures, due to the great development of the clypeus, in the shape of the mandibles, in the reduction of the maxillæ, etc.

In the light, however, of the preceding detailed accounts of the mouth-parts of *Ancistrona*, *Læmobothrium*, *Eurymetopus* and *Goniodes* (Mallophaga), with their detailed descriptions of the œsophageal sclerites and glands, and the "forks" of *Ancistrona* and *Goniodes*, the comparison of the Mallophagous and Psocid mouth structures may profitably be carried farther than has yet been done.

The flattening of the head, with the great development of the clypeus, and the restriction of the mouth-parts to the ventral aspect of the head, so characteristic of the Mallophaga, is quite as characteristic of *Atropos*, the wingless, degraded Psocid. Among the winged Psocidæ the head hangs vertically, and although there is a similar great development of clypeus, there is less flattening of the head and less general resemblance. The peculiar condition of the labrum in the Mallophaga, lying as it does on the ventral aspect of the produced clypeus, finds an identical repetition in *Atropos;* a point which Packard seems to have overlooked when he says that the Mallophaga differ from the Psocids in having the labrum covered by the clypeus. In the winged Psocidæ the head is not horizontal as with the Mallophaga and *Atropos*, and the labrum is attached to the ventral margin of the clypeus.

The mandibles of *Atropos* present a really striking similarity with those of the Amblycerous Mallophaga. The details of teeth, condyles, facets, and musculation are extraordinarily alike.

The maxillæ of the Psocidæ are greatly reduced, retaining, however, a well developed palpus. In the Mallophaga the reduction of the maxillæ is carried still farther, the palpi having become completely atrophied.

The labium of the Psocidæ (of *Atropos* in particular) and of the Mallophaga is modified along essentially similar lines. One important distinction, however, is the presence of well developed labial palpi in one suborder of the Mallophaga.

Not brought out in any previous discussion of the Mallophagous mouth-parts, and, perhaps, more striking than the points of resemblance so far noted, is the practical identity of the œsophageal sclerite and accompanying glands of the Mallophaga, with the characteristic "œsophageal bone" and glands of the Psocidæ. The comparison of these structures in the two groups reveals an agreement in position and character so nearly identical as to preclude any supposition of independent origin. Also, there is to be noted the presence, in certain genera of the Mallophaga, of a pair of "forks," very much reduced in size, and not yet well understood. These forks seem very like the familiar and characteristic Psocid forks, so far apparently found among no other insects.

It is not intended to discuss here, at all, the probable relationship of the Psocidæ and Mallophaga, simply to point out the peculiar and interesting similarity of mouth structures, as so far brought out in the study of the groups. It is of interest to note in this connection the rather similar food habits of the two groups, the Psocidæ feeding on dry, dead organic matter, such as wood and paper, dried insects, and dried bird and mammal skins; and the Mallophaga feeding on the dry, dead dermal scales, hairs, and feathers of mammals and birds. I have found *Atropos* not infrequently in the nests of birds.

DESCRIPTIONS OF NEW SPECIES.

Docophorus.

Docophorus taurocephalus n. sp. (Plate lxv, fig. 1.)

Two males and a female from an American Rough-legged Hawk, *Archibuteo lagopus sancti-johannis* (Lawrence, Kansas). A member of the group dilatatoclypeati, found on eagles and hawks and characterized by the more or less prominent, uncolored frontal expansion of the clypeus. The new form resembles Nitzsch's *gonorhynchus* (Giebel, Insecta Epizoa, p. 70), from *Astur* *nisus*, in the emargination of the clypeus, and it shows, also, what Piaget affirms to be merely an individual character, the effacement of a distinctly limited signature, as spoken of by Nitsch. The new form is markedly larger than *gonorhynchus*, and the male has no transverse linear blotch on the last segment.

Description of male. Body, length 2.06 mm., width 1 mm.; strongly colored.

Head, length .78 mm., width .78 mm.; thus being very large in proportion to the size of the body; front with shallow emargination, the projecting lateral parts angulated; clypeus expanded laterally behind these frontal angles, and the uncolored expanded portion bearing two conspicuous, longish hairs; a short marginal hair just in front of the suture, and two longish hairs rising on dorsal surface and projecting beyond margin between suture and trabeculæ; trabeculæ broad, not reaching beyond end of segment 1 of antenna; eye projecting, pendulous, with angulated cornea, and bearing a hair; temporal margins flatly rounded and bearing four long hairs, and on occipital side of posterior angle a short hair; occipital margin nearly straight, bare; general color of head light translucent brown; signature indistinctly limited, its lateral margins obscured by the strong inner bands; antennal and occipital bands strongly marked and continuous; ocular bands distinctly indicated; suture distinct, interrupting the antennal bands; antennal and inner bands paling anteriorly; temporal regions brown, with narrow darker outer margin.

Prothorax short, broad, with uneven rounding sides, and a single hair in each posterior angle, the angle being slightly tumid; broad, apparently divided, lateral bands pale outwardly, and bending in along the posterior margin of the segment. Metathorax short, with sinuous, very obtusely angled posterior margin, bearing on the mesal third eight weak, non-pustulated hairs, and in the lateral angles two longer and stronger hairs; large, transverse, lateral blotches separated by a narrow, uncolored, mesal, linear space widening anteriorly; legs pale brown, with dark brown markings on dorsal margins of femora and tibiæ.

Abdomen broadly elliptical, short, segments projecting little or not at all at sides, and with two to three long hairs in posterior angles; a single transverse series of hairs on dorsal surface of each segment; lateral transverse blotches large, and with pointed inner ends; lateral bands darker, not distinctly limited; posterior margin of last segment flatly rounded, with numerous longish hairs which are confined to the lateral portions of the margin.

Female. Body, length 2.53 mm., width 1.04 mm.; head, length .87 mm., width .87 mm.; the lateral abdominal blotches much shorter, the hind body tapering posteriorly, and the ninth segment narrow, uncolored, tapering behind, and narrowly angularly emarginated so as to produce two short acute points.

Docophorus alienus n. sp. (Plate lxv, fig. 2.)

Found on a Yellow-shafted Flicker, *Colaptes auratus* (Lawrence, Kansas). This species does not resemble any of Nitzsch's or Piaget's *Docophori* taken from woodpeckers, but belongs to Piaget's group *latifrontes*, found on the cuckoos. The group is characterized, according to Piaget, by the width and emargination of the clypeus, and by the large size of the posterior legs. The clypeal characters are presented by this new form, but the posterior legs are not especially enlarged.

Description of the male. Body, length 1.62 mm., width 7 mm.; the only specimen is a recently moulted one, so that the chitinization is incomplete, and the color is nearly lacking. If it were not for the well marked clypeal characters, which indicate its affinities unmistakably, I should not describe the specimen.

Head, length 56 mm., width 53 mm.; front broad, angularly emarginated; two submarginal hairs between the suture and the anterior angles of the clypeus, of which the hinder is much the longer; a short hair at the suture, and three short ones in front of the trabeculæ; the trabeculæ very long, reaching to end of segment 2 of antennæ; eye prominent, with a hair and black fleck; four longish hairs on temporal margin; occipital and antennal bands pale, but evidently to be well chitinized; signature broad, emarginate on anterior margin.

Prothorax short, with rounding angles, and with single hair in posterior angles; indications of strong, even, lateral bands. Metathorax obtusely angled on abdomen, with a series of pustulated hairs along posterior margin; indications of large lateral blotches. Legs concolorous with body.

Abdomen broadly elliptical, with long hairs in posterior angles of segments, and one transverse row of hairs across each segment; lateral transverse blotches are indicated, and narrow dark lateral bands are present; transverse blotches extending across segment 8; genitalia short, broad, confined to segments 8–9.

Docophorus incisus n. sp. (Plate lxv, fig. 3.)

Found on a Bluebird, *Sialia sialis* (Lawrence, Kansas), and on a Cedar Waxwing, *Ampelis cedrorum* (Lawrence, Kansas).

General characters of *communis*, but with front of clypeus narrower and deeply emarginated; signature with anterior margin emarginated and unevenly chitinized;

temporal angles more convexly rounded; metathorax obtusely angled on abdomen, and with transverse blotch, with posterior margin not parallel with the posterior margin of the segment; thorax relatively broader than in *communis*. Measurements of male: Body, length 1.72 mm., width .75 mm.; head, length .59 mm., width .56 mm. Female: Body, length 2.12 mm., width .90 mm.; head, length .63 mm., width .63 mm.

Docophorus domesticus n. sp. (Plate lxv, fig. 4.)

Males, females, and young taken from the Purple Mar tin, *Progne subis* (Lawrence, Kansas). Most nearly like Nitzsch's *excisus* (Giebel, Insecta Epizoa, p. 88, pl. xi, figs. 1, 2, 3) found on *Hirundo urbica* and *Cypselus apus*, but markedly larger. Piaget calls *excisus* one of the smallest *Docophori* known, and gives the average length of the males as 1. to 1.1 mm., and of the females as 1.2. My specimens average in length, males, 1.47 mm., females, 2 mm.

Description of the male. Body, length 1.47 mm., width .59 mm.; thorax and head pale golden brown, with light brown markings; abdomen darker, with large dark brown lateral blotches.

Head, length .5 mm., width .48 mm.; front of clypeus emarginated rather squarely, the bounding mesal angles of the clypeus nearly rectangular; a longish prominent hair rising from the dorsal surface near the margin in each rounded latero-anterior angle of the clypeus, a short marginal hair behind it, another at the suture, two others close together and rising from the dorsal surface near the margin behind the suture, and a single short, marginal hair just in front of the trabeculæ; the trabeculæ large, acutely pointed, reaching middle of segment 2 of antennæ; antennæ, if projected backwards, reach the posterior margin of the head; eye prominent, with a longish hair; temporal margin with one hair behind, but close to the eye, and two other hairs and two prickles; occipital margin sinuous, bare; signature indistinct, with anterior margin emarginate; no distinct posterior point; occipital bands brown, forking; antennal bands pale smoky brown, interrupted.

Prothorax with rounding sides and angles, rather long, and with a single hair near each end of posterior margin; a broad, even, translucent, lateral band. Metathorax rather long, angulated on abdomen, with a series of pustulated hairs along posterior margin and a broad, lateral, brown band along the antero-lateral sides. Legs robust, pale brown, with dark brown marginal markings and few scattered hairs.

Abdomen broadly elliptical, segments projecting slightly laterally, with one to two or three long hairs in the posterior angles; dorsal surface with numerous weak hairs arranged in transverse lines, a single series on each segment; segments 1–7 with large, dark brown, transverse, lateral blotches, each blotch with an uncolored stigmatal spot, and a few demi-pustulations with hairs along the posterior margin; segment 8 with a curving transverse blotch entirely across segment, and segment 9 wholly colored; a broad uncolored suture between segments 8 and 9; the chitinized parts of the genitalia distinct, short, broad; posterior margin of ninth segment rounded (parabolic) with a few longish hairs.

Female. Body, length 2 mm., width .84 mm.; head, length .56 mm., width .56 mm.; last segment of abdomen with slight angular emargination; genital blotch large, conspicuous.

Docophorus distinctus n. sp. (Plate lxv, fig. 5.)

Many specimens, males, females, and young, from the American Raven, *Corvus corax sinuatus* (Colorado). This form belongs to the *corvinicolæ* infesting the Corvini and is of the type *atropicti* characterized by the whitish ground color of the body, and sharp black markings. The new species differs from Nitzsch's *atratus* (Giebel, Insecta Epizoa, p. 81, pl. ix, fig. 10) from *Corvus frugilegus* by the long hairs of the clypeus; from Nizsch's *ocellatus* (Giebel, Insecta Epizoa, p. 81, pl. ix, figs. 7 and 8), from *C. cornix* and *C. corone*, by lacking the strongly marked bands on the temples, and by the short signatures; and differs from Piaget's *albidus* (Les Pediculines, p. 48, pl. iii, fig. 6) from *C. scapulatus* by the pustulated hairs of temples and metathorax.

Description of the male. Body, length 2 mm., width 1.06 mm.; ground color whitish with distinct, sharply defined, black markings.

Head, length .63 mm., width .72 mm.; very broad in front and truncate; five long marginal hairs on each side of forehead, one at base of antennæ, one in eye, one just behind the eye, and three on the temporal margins; occipital margin straight, bare; antennæ with segment 1 large and swollen, segment 2 slender and longest, segments 3–5 short, subequal and colored dark brown, segments 1–2 uncolored; signature very short, or at least with only a short, oblong, anterior part colored; antennal bands broad, irregular, interrupted at the suture, and with subparallel inner bands; occipital bands very distinct, diverging and meeting the expanded basal extremities of the antennal bands; ocular bands narrow, distinct, and extending around behind the eye; a shield-shaped occipital signature showing through.

Prothorax narrow, with strong, black, lateral borders, and a fainter narrow diagonal line running inward and backward from each side; the pericoxal and intercoxal lines of prosternum showing through; one hair in each posterior angle. Metathorax angulated on abdomen, with a series of pustulated hairs along posterior margin; antero-lateral sides with strong black border; postero-lateral sides with paler, brown, linear, tapering blotch. Legs concolorous with body, with black marginal and annular markings.

Abdomen very broadly elliptical, suborbicular; not turbinated; with long weak hairs in posterior angles; last segment flatly rounded behind; the transverse lateral blotches smoky brown, with darker lateral borders, large uncolored stigmatal spots, and about six demi-pulstulations along the posterior margin of each blotch; some of the outermost of these pustulations are complete; many weak hairs on dorsal surface; genitalia showing distinctly in segments 6–9, broad and shortly three-pronged posteriorly; segment 8 with transverse blotch entirely across segment; segment 9 uncolored.

Female. Body, length 2.5 mm., width 1.34 mm.; head, length .72 mm., width .81.; abdomen more elongate, the lateral transverse blotches a little shorter, the posterior margin of the last segment with shallow emargination; last segment with two short, longitudinal, lateral blotches; a broad semielliptical genital blotch with backward-projecting mesal point showing through from below.

Docophorus transpositus n. sp. (Plate lxv, fig. 6.)

A single female from a Cow Bunting, *Molothrus ater* (Lawrence, Kansas). This new *Docophorus* is a member of Piaget's group *forficulati*, whose members have been found hitherto only on the Psittacinæ. The distinguishing character of the group is the forcipated clypeal front.

This forcipated clypeus is found also in *D. pertusus* N. (on *Fulica*) of the group *emarginati*.

Description of female. Body, length 2 mm., width .9 mm.; forehead light golden brown, hindhead dark brown, thorax and abdomen strongly blotched with dark brown, abdomen with interrupted narrow, black, lateral bands.

Head, length .56 mm., width .59 mm.; front with a subcircular emargination enclosed in front by mesad-projecting, acute, forceps-like points; no marginal hairs on forehead excepting three or four short ones just in front of trabeculæ; the trabeculæ are rather long, reaching beyond end of segment 1 of antenna; eye with a hair; temporal margins with two longish hairs and a short one between them; occipital margin sinuous, bare; signature broad and very pale, and indistinct anteriorly, with a short, obtuse, posterior point which is darker colored; antennal bands broad, short, paling into general color of forehead; ocular bands fairly distinct, as also the occipital bands; temporal regions dark brown with narrow blackish border outwardly; a narrow black occipital border.

Prothorax with rounding sides and angles, with a single weak hair in each posterior angle; broad, dark brown lateral borders paling outwardly and darkest in posterior angles; two indistinct narrow dark lines running diagonally inward from each lateral border. Metathorax with rounding lateral angles, obtusely angled on abdomen and with a series of pustulated hairs along posterior margin; two linear transversal blackish blotches projecting inward from each side, the anterior blotch much the larger and more distinct. Legs dark brown with blackish marginal markings and semiannulations at extremities of femora.

Abdomen obovate, sides somewhat turbinate but with the projecting angles rounded; segments 3–6 with two or three short hairs in posterior angles, segment 7 with one hair in angle; segment 8 much narrower than segment 7 and somewhat retracted into it; segment 9 hardly visible, being almost wholly concealed within segment 8; segment 1 with complete transverse blotch deeply medianly emarginated on its anterior margin; segments 2–7 with lateral, dark brown, transverse blotches separated by the paler median third of the body surface and blunt within; each blotch with a distinct uncolored stigmatal spot, but without pustulated hairs; blotch of segment 8 extending entirely across segment; four longitudinal rows of weak nonpustulated hairs, two rows in median paler space, and one row in each lateral series of transverse blotches; distinct, black, lateral bands widening posteriorly and segmentally interrupted.

Docophorus evagans n. sp. (Plate lxvi, fig. 2.)

Taken from the Downy Woodpecker, *Dryobates pubescens* (Lawrence, Kansas). This *Docophorus* is a member of Piaget's woodpecker infesting group *angustifrontes*, characterized by the anterior narrowing of the head with small trabeculæ, and the elongate Nirmoid form of the body. It departs from the more typical forms of the group, however, in the relatively wide clypeal front.

Description of male. Body, length 2 mm., width .62 mm.; body color pale yellowish brown, with narrow dark brown marginal markings.

Head, length .53 mm., width .47 mm.; triangular but relatively longer, and with wider frontal apex than in other *Docophori* of this group; two very short hairs in anterior clypeal angles, one at suture and two in front of trabeculæ; the trabeculæ are acute and reach to the end of segment 1 of antennæ; antennæ slender; eye not prominent, with a hair and small black fleck; temporal margins with two longish hairs; occipital margin weakly concave, almost straight and bare; narrow antennal bands, and temporal borders shining dark brown.

Prothorax short, with narrow marginal band and no hairs. Metathorax acutely angled on abdomen, the angle produced; beginning in lateral angle five long hairs along each latero-posterior margin, the mesal third of the posterior margin being free from hairs; a narrow, indistinct, lateral border. Legs concolorous with body, with narrow, dark brown, marginal markings. Sternum with narrow distinct intercoxal lines.

Abdomen elongate, subparallel-sided; a single longish hair in posterior angles of segments 3–4, and two hairs in angles of segments 5–8; two hairs also in middle of lateral margin of segment 8; segment 9 uncolored, narrowed and slightly emarginated behind; narrow, translucent, brown lateral bands, and faint indications of median transversal blotches which are probably the light brown transversal blotches of the under side showing through.

Docophorus jungens n. sp. (Plate lxvi, fig. 4.)

Found on two specimens of the Flicker, *Colaptes auratus* (Lawrence, Kansas). The new form belongs to Piaget's group *angustifrontes*, found on the woodpeckers, and presents the characteristic narrow clypeal front, the small trabeculæ, and elongate Nirmoid body. The members of the group undoubtedly stand in the position of gradatory forms between *Docophorus* and *Nirmus*.

Description of the male. Body, length 1.75 mm., width .65 mm.; very pale brownish, with darker marginal markings.

Head, length .56 mm., width .50 mm.; triangular, with narrow, anteriorly tapering clypeus which is concave in front; two short hairs just beyond the anterior angles, one short hair at the suture, and two slightly longer ones in front of the rather small trabeculæ; eye distinct, with a long hair; temporal margins flatly convex, with two long hairs; occipital margin weakly concave and sinuous, bare; ground color of head pale yellowish brown with narrow dark brown antennal bands, pale colored signature and narrow brown temporal margins fading out posteriorly; œsophageal sclerite showing through, and occipital bands indicated, especially at their posterior ends.

Prothorax small, with slightly rounded rectangular posterior angles and straight posterior margin, with one hair in posterior angles; pale lateral borders which bend inward at posterior angles. Metathorax short, broad, angulated on abdomen, with indistinct lateral blotch and six hairs along each latero-posterior margin arranged in two groups of three each. Legs concolorous with the pale body, with darker marginal blotches on femora and tibiæ.

Abdomen narrow, with few longish hairs in posterior angles of segments and a transverse series of a few longish hairs across each segment interrupted in the middle; lateral bands translucent pale brown, the segmental portions passing the sutures and projecting somewhat inward; indications of median transverse bands; last segment conspicuous, projecting, flatly rounded behind, and with a few longish hairs; genitalia showing through body wall.

Female. Body, length 1.93 mm., width .68 mm.; head, length .56 mm., width .58 mm.; abdomen more elongate and subparallel-sided; eighth segment with transverse blotch entirely across segment; ninth segment slightly angularly emarginate behind.

Docophorus californiensis n. sp. (Plate lxvi, fig. 6.)

Numerous specimens, male, female, and young from several specimens of the California Woodpecker, *Melanerpes formicivorous bairdi* (Palo Alto, California). Another member of the *angustifrontes*, of same size and outline as the last, but with strong and characteristic markings. It is very like *D. superciliosus* N. (Giebel, Insecta Epizoa, p. 94, pl. x, fig. 3), the type of the group taken by Nitzsch, Denny, and Piaget from *Picus major* and *P. viridis*. It appears to differ from *superciliosus* in the possession of hairs in the posterior angles of the prothorax, in the absence of numerous hairs on dorsal surface of abdomen, and in the sharper and more pronounced markings.

Description of the male. Body, length 1.75 mm., width .62 mm.; pale smoky brown, with dark brown to black bands and blotches.

Head, length .53 mm., width .47 mm.; triangular, forehead tapering, and clypeal front narrow and slightly concave, with two hairs in the anterior angles, one shorter one between angle and suture, a longer one just in front of suture, and two rather long ones in front of trabeculæ; eye prominent, with long hair; trabeculæ acute, reaching slightly beyond end of segment 1 of antennæ; temporal margins with two long hairs and a prickle; occipital margin sinuous, bare; clypeus paler than rest of forehead and hind head; signature pale but distinct; suture distinct; antennal bands, ocular blotch, and anterior temporal border blackish brown; temporal regions and rest of head, excepting clypeus and that part of hind head between the occipital bands, dark brown; œsophageal sclerite distinct.

Prothorax short, projecting considerably beneath head; posterior angles rectangular, with one hair; posterior margin evenly flatly convex; lateral border curving inwards along posterior margin blackish brown. Metathorax short; lateral angles obtusely rounding; posterior margin with obtuse produced angle and four or five hairs on each side; uneven lateral border and transverse blotch not contiguous to posterior margin, dark brown. Sternal markings consisting of intercoxal lines. Legs concolorous with pale smoky brown of body, with black marginal markings.

Abdomen elongate, about one-third wider than head, with few long hairs in very slightly projecting posterior angles of segments; a few hairs arranged in five uneven, longitudinal rows on dorsal surface; broad, pronounced, blackish, lateral bands, with distinct uncolored stigmatal spots and broad transverse blotches extending from band to band on segments 1–8; the blotches on segments 1–2 deeply emarginated medially on anterior margin, and the blotch on segment 7 faint in median part; segment 9 projecting, rounding, with several long hairs on posterior margin and a median blotch; genitalia showing in segments 7–9.

Female. Body, length 1.9 mm., width .72 mm.; head, length .6 mm., width .53 mm.; last segment of abdomen slightly angularly notched.

Docophorus cursor Nitzsch. (Plate lxvi, fig. 1.)

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1861, vol. xvii, p. 527.

Philopterus cursor N., Walckenær, Hist. Nat. Ins. Apt.; 1844, vol. iii, p. 341.

Docophorus cursor N., Burmeister, Handb. d. Ent., 1835, vol. ii, p. 426; Denny, Monograph. Anoplur. Brit., 1842, p. 101, pl. ii, fig. 1; Giebel, Insecta Epizoa, 1874, p. 75, pl. xi, figs. 5, 6; Piaget, Les Pediculines, 1880, p. 24, pl. i, fig. 5.

Many specimens from a Great Horned Owl, *Bubo virginianus* (Lawrence, Kansas). Nitzsch's type specimens were collected from *Strix bubo*, and he later took specimens from *Strix otus* and *Strix brachyotus*. Denny collected the species from *Otus (Strix) vulgaris* and *Otus (Strix) brachyotus*, and Piaget from *Strix brachyotus* and from *Falco tinnunculus*. Picaglia (Pediculini dell' istituto anatomo-zoologico d. r. Univ. di Modena, Atti d. Soc. d. Nat. di Modena, 1885, ser. iii, vol. iv, p. 13) records *Bubo maximus*, *Otus vulgaris*, *O. brachyotus*, and *Tinnunculus alaudarius* as hosts of *cursor*. There is some discrepancy between Giebel's and Piaget's description of the species, especially touching the lateral emargination of the forehead, a character which, according to Piaget, is noticeable, and which indicates the affinities of *cursor* and the hawk-infesting *Docophori*. My specimens vary noticeably from the descriptions of the Old World forms, especially in the distinctly pendulous eye and the character of the genital blotches. They are also larger than the European specimens. Probably they should be given a varietal name. The species may be recognized by comparison with the figure. In the male the lateral abdominal blotches cover much more of the abdominal surface of course, and the specimens are smaller. My specimens measure—Male: Body, length 1.9 mm., width .75 mm.; head, length .62 mm., width .62 mm. Female: Body, length 2.22 mm., width .9 mm.; head, length .66 mm., width .66 mm.

Docophorus ceblebrachys Nitzsch (Plate lxvi, fig. 3).

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1861, vol. xvii, p. 528.

Docophorus ceblebrachys N., Denny, Monograph. Anoplur. Brit., 1842, p. 92, pl. i, fig. 3; Giebel, Insecta Epizoa, 1874, p. 77, pl. xi, fig. 15; Piaget, Les Pediculines, 1880, p. 29, pl. i, fig. 8.

Numerous specimens from two Snowy Owls, *Nyctea nyctea* (Lawrence, Kansas). Taken by Nitzsch, Denny and Piaget on individuals of the same bird species. A distinctly marked and isolated form peculiar, probably, to the Snowy Owl. It can be readily recognized by the broad short head, with short broadly truncate forehead, and correspondingly short and broad signature. The genital blotches of the ventral surface of the abdomen of both male and female are also characteristic. There is considerable difference in size of the male and female. The male which I figure measures: Body, length 1.78 mm., width .75 mm.; head, length .53 mm., width .6 mm. Female: Body, length 2.31 mm., width 1.03 mm.; head, length .62 mm., width .75 mm.

Docophorus rostratus Nitzsch. (Plate lxvi, fig. 5).

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1861, vol. xvii, p. 529.

Docophorus rostratus N., Giebel, Zeitschr. f. ges. Naturwiss, 1861, vol. xviii, p. 296; Burmeister, Handb. d. Ent., 1835, vol. ii, p. 427; Denny, Monograph. Anoplur. Brit., 1842, p. 87, pl. ii, fig. 4; Giebel, Insecta Epizoa, 1874, p. 76, pl. x, fig. 4; Piaget, Les Pediculines, p. 27, pl. i, fig. 7.

Two specimens of this unmistakable *Docophorus*, taken by Nitzsch, Denny and Piaget from *Strix flammea*, the European Barn Owl; taken by me from the American Barn Owl, *Strix pratincola* (Soquel, California). The American Barn Owl has always, until recently, been held to be simply a variety *(Strix f. pratincola)* of the European Barn Owl. The specimen figured by me measures: Body, length 1.97 mm., width .5 mm.; head, length .75 mm., width .53 mm. The species is readily recognizable by its slender abdomen and its very long head, with narrow extended forehead. The head and thorax are longer than the abdomen.

Docophorus communis Nitzsch. (Plate lxvi, fig. 7.)

Germar's Mag. f. Ent., 1818, vol. iii, p. 290.

The following synonymy is that given by Picaglia in his Pediculini dell 'Istituto anatomo-zoologico della R.

Universita di Modena, Atti della Societa dei Naturalisti di Modena, Serie 3, vol. iv, 1895.

> "Sinonimia—De-Geer. Mem. Ins. vol. vii, tv. 4, f. 9. 1776 (*Ricinus emberizæ*)—Schrank. Beit. zur Naturg. p. 117, tv. 5, f. 8. 1776 (*Pediculus curvirostræ*)—l. c. p. 117, f. 6 (*P. Pyrrulæ*)—l. c. p. 118, f. 7 (*P. Chloridis*)—l. c. p. 116, f. 9 (*P. citrinellæ*)—l. c. p. 115, f. 10 (*P. Rubeculæ*)—Linneo. Syst. Nat. Ed. xiii, v. ii, p. 2922. 1789 (*P. curvirostræ, Pyrrulæ, Chloridis, Citrinellæ, Rubeculæ*)—Panzer. Fau. Ins. Germ. p. 51, f. 27. 1793 (*P. Curvirostræ*)—Geoffroy. Hist. abr. Ins. v. 11, p. 599. 1800 (*Pediculus Emberizæ*)—Latreille. Hist. Gen. v. viii, p. 111. 1804 (*Ricinus Emberizæ*)—Fabricus. Sys. Ant. p. 349. 1805 (*P. Emberizæ*)—Olfers. De Veg. et. Anim. Corp. Anim. Rep. 1815 (*Nirmus globifer*)—Nitzsch. Germ. Mag. v. iii, p. 290. 1818—Burmeister. Hand. Ent. v. ii, p. 425. 1835—l. c. (*fusicollis*)—Denny. Anop. p. 70, tv. 5, f. 10. 1842—l. c. p. 82, tv. 1, f. 8 (*pallescens*)—l. c. p. 98, tv. 1, f. 8 (*fuscicollis*)—l. c. p. 104, tv. 5, f. 12 (*Passerinus*)—l. c. p. 106, tv. 3, f. 1 (*Merulæ*)—l. c. p. 107, tv. 3, f. 3 (*Modularis*)—l. c. p. 108, tv. 2, f. 2 (*Rubeculæ*)—Walckenær. Hist. Nat. Ins. Apt. v. iii, p. 332. 1844 (*Philopterus*)—l. c. p. 336 (*Philopterus pallescens*)—l. c. (*Philopterus fuscicollis*)—l. c. p. 340 (*Philopterus passerinus, merulæ, modularis, rubeculæ*)—Giebel. Zeits. f. ges. Nat. Bd. xvii, p. 298–303. 1861—l. c. (*fuscicollis*) p. 298—l. c. Bd. xviii, p. 298–303. 1861—l. c. p. 298. 1861 (*fuscicollis*)—Giglioli, Jour. of Micros. N. 10, tv. B, f. 9. 1864 (*Mandarinus*)—Giebel. Zeits. f. ges. Nat. Bd. xxvii, p. 116. 1866 (*ornatus*)—l. c. Bd. xxvii, p. 358. 1866—l. c. p. 359 (*fuscicollis*)—l. c. p. 359 (*ornatus*)—Epiz. p. 85, tv. xi, f. 13. 1884—l. c. p. 86, tv. 11, f. 10, tv. 20, f. 4 (*fuscicollis*)—l. c. p. 89 (*ornatus*)—l. c. p, 120 (*Rubeculæ, Modularis, Merulæ*)—l. c. p. 119 (*turdi*)—l. c. p. 91 (*lineatus*)—Piaget. Ped. p. 54, tv. 4, f. 2, 3, 4, 5, 7 (sp. et var.)."

The specific name *communis* given by Nitzsch to a *Docophorus* species or group of closely allied species found commonly on passerine birds, has been retained by Giebel and Piaget as the best, or, at least, most convenient expression of the condition exhibited by the *Docophori* of the type figured by Nitzsch from specimens from *Fringilla linaria*, and by Piaget from specimens from *Motacilla alba* and others. Specimens of this type are the most commonly met with *Docophorus* on passerine birds, and have been recorded from many species. Picaglia (l. c., p. 16) lists 43 species of European Passeres from which *communis* has been collected. But the variations exhibited by the specimens from the various bird species are many and sometimes striking. Giebel refers to variations exhibited by specimens from certain birds as being sufficient to warrant the founding of new species, but he merely refers to the general character of the variation shown by specimens from *Turdus pilaris*, *Parus major*, *Fringilla chloris*, and *Motacilla alba*. He lists 29 passerine birds representing 15 genera on which *communis* had been found at time of his writing. Piaget holds to the single species *communis*, referring to the variations apparent in any series of specimens, and describes and gives varietal names to 11 varieties. He selects the form found on *Motacilla alba* as typical of the species (believing it to be the same as found by Nitzsh on *Fringilla linaria*) and lists nearly 20 passerine bird species on which he has found *communis* and its varieties.

I have collected specimens of this *communis* species or group of species from the following American passerine birds: the Horned Lark, *Otocoris alpestris;* Red-winged Blackbird, *Agelaius phœniceus;* Western Meadowlark, *Sturnella magna neglecta;* Lapland Longspur, *Calcarius lapponicus;* Slate-colored Junco, *Junco hyemalis;* Cardinal Grosbeak, *Cardinalis cardinalis;* Bohemian Waxwing, *Ampelis garrulus;* White-rumped Shrike, *Lanius ludovicianus excubitorides;* Brown Thrasher, *Harporhynchus rufous;* and the Robin, *Merula migratoria*—all from Lawrence, Kansas; and also from Bullock's Oriole, *Icterus bullocki;* the California Purple Finch, *Carpodacus purpureus californicus;* the House Finch, *Carpodacus mexicanus frontalis;* the Pine Siskin, *Spinus pinus;* the Arkansas Goldfinch, *Spinus psaltria;* and the Sandwich Sparrow, *Amodramus sandwichensis*, from Palo Alto, California.

Variations among the specimens are apparent, but until I can examine a much larger series no attempt can be made to tabulate these variations. The species may be recognized by comparison with the figure in plate lxvi. This specimen, a female, was taken from a White-rumped Shrike, *Lanius ludovicianus excubitorides* (Lawrence, Kansas), and measures: Body, length 2. mm.; width .87 mm.; head, length 6 mm.; width .6 mm.

Docophorus excisus Nitzsch.

Germar's Mag. f. Ent., 1818, vol. iii, p. 291.

Pediculus hirundinis Linnæus, Fau. Suec., 1746, p. 1963; Schrank, Fauna Boica, 1781; Fabricius, Sp. Ins., 1783, vol. ii, p. 483; Linnæus, Syst. Nat., ed. 13, 1779, vol. i, p. 2921.

Ricinus hirundinis Latreille, Hist. Gen., 1804, vol. viii, p. 111.

Philopterus excisus Nitzsch, Germ. Mag. f. Ent., 1818, vol. iii, p. 291; Burmeister, Handb. d. Ent., 1835, vol. ii, p. 425; Walckenaer, Hist. Nat. Ins. Apt., 1844, vol. iii, p. 333.

Docophorus excisus Nitzsch, Giebel, Zeitschr. f. ges. Naturwiss., 1861, vol. xviii, p. 298, l. c. 1866, vol. xxviii, p. 359; Giebel, Insecta Epizoa, 1874, p. 88, pl. ix, figs. 1, 2, 3; Piaget, Les Pediculines, 1880, p. 64, pl. iv, fig. 6.

Specimens which may be referred to this long known parasite of the swallows taken from the Cliff Swallow, *Petrochelidon lunifrons*, and from the Tree Swallow, *Tachycineta bicolor* (Palo Alto, California, and Lawrence, Kansas). The American specimens are, however, markedly larger than the European ones and should be designated by a varietal name. Piaget's measurements are, for males, length 1 m., for females 1.1 mm.; the males among my specimens are about 1.3 mm. long and the females 1.5 mm. long. The species of this group (with square emargination of clypeal front) which I have described from the Purple Martin (see page 475, plate lxv, fig. 4) shows all of the general habitus of *excisus*, but is so conspicuously larger and presents such constant minor differences that I have made it the type of a new species. The figure of it, however, will serve very well as a means of recognizing the American variety of *excisus*.

Var. *major* Kellogg. Male. Body, length 1.3 mm., width .56 mm.; head, length .44 mm., width .40 mm. Female. Body, length 1.49 mm., width .62 mm.; head, length .45 mm., width .42 mm.; the pustulations in lateral abdominal blotches more complete and distinct than in the type form of the species. Males, females, and young found on the Cliff Swallow, *Petrochelidon lunifrons*, and on the Tree Swallow, *Tachycineta bicolor* (Palo Alto, California, and Lawrence, Kansas).

NIRMUS.

Nirmus longus n. sp. (Plate lxvii, fig. 1.)

Taken from the Tree Swallow, *Tachycineta bicolor* (Lawrence, Kansas), and from the Cliff Swallow, *Petrochelidon lunifrons* (Palo Alto, California). A member of the group *interruptofasciati* and allied to Nitzsch's *N. gracilis* (Insecta Epizoa, p. 143, pl. vi, figs. 11, 12), which is only half as large and has but four (Giebel) or two (Piaget) hairs on posterior margin of metathorax, and to Denny's *elongatus* (Monograph. Anoplur. Brit., p. 140, pl. vii, fig. 4), which has the posterior margin of the metathorax "strongly ciliate," the hairs in Denny's figure being ranged thickly along the entire length of the margin. Both of these two allied species were taken from *Hirundo urbica*.

Description of female. Body, length 2.03 mm., width .38 mm.; very elongate, pale yellowish brown, with chestnut brown lateral bands and marginal head markings.

Head, length .37 mm., width .28 mm.; elongate-conical, with narrow truncate front; two very small marginal hairs near the front, and one slightly longer a little distance in front of the trabeculæ which are small but distinct; eye flat, with a prickle in its posterior margin; temporal margins flat with a long hair and a prickle; pale golden brown with dark brown narrow antennal bands and temporal borders; oral fossa elongate, expanded behind, nearly uncolored.

Prothorax short, small, oblong, with single short hair in posterior angle, and even lateral borders which bend inward along posterior margin. Metathorax trapezoidal, with lateral margins converging anteriorly; posterior margin straight or weakly convex on abdomen, more curved at each end which projects laterally beyond the abdomen; posterior margin with six longish but weak hairs on each lateral third; indistinct lateral borders with anterior ends more distinct and a diagonal line projecting inward and forward from the posterior angles. No pronounced sternal markings. Legs pale, concolorous with body, with narrow darker marginal markings.

Abdomen very long and apparently slender, although really one-third wider than head; abdominal segments very gradually growing wider until segment 6 is reached, segment 7 slightly narrower, segments 8–9 narrower, abruptly tapering; a single short hair in posterior angles of segments; dorsal surface naked; segments 1–7 with distinct chestnut brown lateral bands; segment 8 of general body color; segment 9 uncolored, emarginated behind, with rounded points.

Male. Two males, which with much hesitancy I assign to this species, taken from a Cliff Swallow, *Petrochelidon lunifrons* (Palo Alto, California), are much smaller than the females. This condition is similar to that presented by *gracilis*, the males of which are .7 mm. long, while the females are .95 mm. long. The arrangement and number of metathoracic hairs are the same as in the females, and the head characters agree. Measurements of the male: Body, length 1.47 mm., width .43 mm.; head, length .34 mm., width .31 mm.

Nirmus simplex n. sp. (Plate lxvii, fig. 2.)

Found on a Robin, *Merula migratoria* (Lawrence, Kansas). It belongs to Piaget's group *interruptofasciati*, with antennal bands interrupted, with temples tending to become angular, and with the body blotches indistinctly colored.

Description of female. Body, length 1.77 mm., width .62 mm.; very pale yellowish brown, with darker but inconspicuous markings.

Head, length .53 mm., width .50 mm.; bluntly triangular, the rather narrow clypeal front truncate or very weakly concave; a single short hair in anterior angles and two other shorter ones on lateral margins; trabeculæ small, acute; eye flat, with a prickle in posterior edge; temporal margins flatly convex, with a single long hair and two prickles just in front of it; occipital margin straight, bare; signature indistinctly colored, broad, emarginate in front and truncate behind; antennal bands distinct, narrow and finely crenate on inner margin; occipital bands indistinct, narrow, extending to posterior rami of mandibles; temporal margins for a little distance behind eye narrowly bordered; antennæ uncolored, fifth segment longer than third or fourth.

Prothorax short, broad, with lateral margins converging anteriorly; a single strong hair in posterior angles; posterior margin flatly convex; rather broad lateral borders, which extend inward along the posterior margin.

Metathorax broad, short, obtusely angled on the abdomen, with a series of non-pustulated hairs along posterior margin; a lateral marginal blotch with a part extending inward. Legs concolorous with body, with only faintly indicated marginal markings.

Abdomen bluntly elliptical, one-fifth wider than the head; with one to two or three weak hairs in posterior angles of segments, and a single transverse series of short weak hairs along the posterior margin of each segment; translucent, smoky brown lateral bands, and pale brown, broad, transverse blotches entirely across all segments; distinct uncolored stigmatal spots; segment 9 uncolored, with two small pale brown lateral blotches, slightly emarginated behind, and with a few longish hairs.

Nirmus eustigmus n. sp. (Plate lxvii, fig. 3.)

A single female of this well marked form from an Anna's Hummingbird, *Trochilus anna* (Palo Alto, California). The species belong to Piaget's group *interruptofasciati*. It is a much broader and much more robust form than *N. vulgatus*, the *Nirmus* of this group common among passerine birds, and the lateral bands of the abdomen are broad and pronounced.

Description of the female. Body, length 1.84 mm., width .62 mm.; pale yellowish white, with narrow blackish brown head borders, and broad, blackish lateral abdominal bands; indications of pale brown abdominal blotches.

Head, length .42 mm., width .45 mm.; broadly triangular, narrowly truncate in front; a few short weak hairs along margins of forehead, the longest being a pair considerably in front of the trabeculæ; trabeculæ small and uncolored but distinct; antennæ short, segment 2 most colored, segment 3 next; eye with a prickle; temporal margins with a single long hair and some fine prickles; occipital margin straight, bare; antennal bands blackish brown, not quite meeting in front, leaving a small uncolored space on frontal margin, and bending angularly in at posterior ends; narrow blackish brown ocular and temporal margins, paling gradually inward from margin of head.

Prothorax short, rectangular, with a single hair in posterior angles; blackish brown lateral borders. Metathorax trapezoidal, posterior margin very flatly convex on abdomen, with an angular indication at middle; six pustulated hairs on each outer third of the posterior margin; broad, ill-defined lateral border, with transversal lateral blotch extending from each side. Legs pale, with blackish brown dorsal marginal markings. Sternum with intercoxal lines but no median blotches.

Abdomen, elliptical; broad for this group of *Nirmi*, with posterior angles of segments, uncolored, blunt, projecting slightly; two or three hairs in posterior angles and a series of four longish hairs on the posterior margin of each of segments 2-7; segment 1 without hairs, and segment 8 with more than four hairs; whitish, with distinct broad, blackish lateral bands, and pale brownish median blotches; segment 8 without lateral bands, but with narrow transversal median blotch reaching almost entirely across segment; segment 9 uncolored, slightly angularly emarginated behind.

Nirmus illustris n. sp. (Plate lxvii, fig. 4.)

Found on a Red-winged Blackbird, *Agelaius phœniceus* (Lawrence, Kansas). This small but striking *Nirmus* does not show special resemblance to any previously described species.

Description of male. Body, length 1.56 mm., width .52 mm.; whitish, with brown median blotches and black marginal bands.

Head, length .37 mm., width 37 mm.; truncate or very slightly convex in front, with two or three very short indistinct marginal hairs; trabeculæ small and weak, reaching half way to segment 1 of antennæ; eye indistinct, with a fine prickle; temporal margins with two prickles and a weak hair; occipital margin straight, bare; antennæ with segment 1 uncolored; other segments dark brown, with wide uncolored sutures; antennal bands narrow, black, angulated almost at right angles and with the black color interrupted just in front of the angulation; bases of antennal bands meeting the inner ends of distinct, narrow, ocular bands whose outer ends meet anterior ends of narrow black temporal borders, with inner margins slightly crenate; short black internal bands parallel with anterior marginal parts of antennal bands; a shield-shaped occipital signature and oblong blotches at its sides showing through from under side.

Prothorax with flatly rounded sides and rounded posterior angles, each angle bearing one small hair; anterior angles containing a large dark brown blotch, and intercoxal lines of sternum showing through as black diagonal lines in posterior angles. Metathorax with rounding margins, rounded on abdomen, with five weak hairs in each lateral fourth of the posterior margin; small black linear blotches in anterior angles, and large irregular black lateral blotches not contiguous to the lateral margins, the sternal markings showing through dark chestnut brown. Sternal markings consisting of intercoxal lines and a median blotch on metasternum. Legs, femora and tibiæ with dorsal marginal black markings and a blackish brown annulation near distal extremity; tarsi paler brown.

Abdomen elongate, subparallel-sided, with posterior angles of segments projecting slightly, pointing backward and each bearing two weak hairs; dorsal surface of segments naked; last segment projecting, parabolic behind, with two pairs of long weak hairs and one pair of shorter ones; lateral bands narrow, distinct, black, interrupted, the anterior end of each segmental portion projecting beyond the suture and slightly inward; large median chestnut brown blotches on segments 1–7, each of these blotches (except that on segment 1) nearly crossed by a transverse linear uncolored space; on segments 6–7 the uncolored space is divided into two portions; in addition there are on segments 3–7 a pair of transversal dark brown lines, one on each side of the median line and lying superposed on median blotch, but extending a little farther laterally than the lateral margin of the blotch; some of these markings are on the ventral surface, but show through distinctly; segment 8 has a median blotch and two lateral markings composed of a brown line defining an elongate curving triangle, uncolored within; segment 9 has a median blotch and from its posterior margin two anteriorly projecting lines; distinct, slender, curving side pieces of genitalia limited to segment 8.

Nirmus vulgatus n. sp. (Plate lxvii, fig. 5.)

This small *Nirmus* of Piaget's group *interruptofasciati* is rather common on Passerine birds. I have taken it from the California Purple Finch, *Carpodacus purpureus californicus;* the House Finch, *Carpodacus mexicanus frontalis;* the Golden-crowned Sparrow, *Zonotrichia coronata;* Gambel's Sparrow, *Zonotrichia gambeli;* the Spurred Towhee, *Pipilo maculatus megalonyx;* the California Towhee, *Pipilo fuscus crissalis;* all from Palo Alto, California; and from the Slate-colored Junco, *Junco* *hyemalis*, and the Robin, *Merula migratoria*, from Lawrence, Kansas.

It is allied to Nitzsch's *densilimbus (Fringilla carduelis)* (Giebel, Insecta Epizoa, p. 138), Piaget's *deficiens* (Les Pediculines, Supplement, p. 23, pl. iii, fig. 3) from *Cyanapolius cooki*, and other similar forms.

Description of female. Body, length 1.62 mm., width .41 mm.; pale, with distinct narrow blackish brown lateral bands and marginal head markings, and pale chestnut median abdominal blotches.

Head, length .37 mm., width .29 mm.; conical, with narrow parabolic front, without hairs; trabeculæ very small and uncolored but distinct; eye flat, with a fine prickle, and another just at its posterior margin; temporal margins with one longish hair and two prickles; occipital margin straight, bare; no signature; a longitudinal oral fossa expanded laterally behind; whole head narrowly bordered along lateral margins with blackish brown, the border turning angularly inward at antennal fossæ; a pale shield-shaped occipital signature showing through from below.

Prothorax narrow, quadrangular, with a single hair in posterior angles; narrow lateral blackish brown border, most strongly colored in anterior and posterior angles. Metathorax almost as wide as head, with flatly rounding posterior margin, with six hairs along each lateral third of this margin, a small transversal linear blackish blotch in anterior angle, and a larger lateral irregular curving blackish blotch in middle of lateral regions of segment. Legs with pale brown ground color, mostly tinged with translucent smoky brown and with darker marginal and annular markings.

Abdomen elongate, slender, subparallel-sided, not tapering posteriorly until segment 8 is reached; with short weak single hairs in posterior angles of segments and naked dorsal surface; pale ground color, with narrow, distinct, dark brown lateral bands and paler broad, rectangular transverse blotches, darker on posterior segments; a rather broad uncolored median longitudinal line; segment 1 with transverse blotch entirely across segment; segment 9 uncolored, narrowly notched, and with few long but weak hairs.

Male. Body, length 1.47 mm., width .4 mm.; head, length .33 mm., width .28 mm.; last abdominal segment protruding, narrowly rounded, with a pair of hairs (one longish, one short) on each side of the middle of the posterior margin; genitalia composed of narrow bars, and showing through in segments 8 and 9.

Nirmus discocephalus Nitzsch. (Plate lxvii, fig. 6.)

Germar's Mag. Entomol., 1818, vol. iii, p. 291.

Nirmus discocephalus Nitzsch, Burmeister, Handbuch d. Ent., 1835, vol. ii, p. 430; Denny, Monograph. Anoplur. Brit., 1842, p. 113, pl. ix, fig. 10; Giebel, Insecta Epizoa, 1874, p. 127, pl. vii, fig. 10; Piaget, Les Pediculines, 1880, p. 129, Supplement, 1885, p. 18, pl. ii, fig. 7.

My specimens, taken from a Bald Eagle, *Haliæetus leucocephalus* (Lawrence, Kansas), may be referred to this characteristic *Nirmus* species of the eagles, found by Nitzsch, Denny and Piaget on the European Gray Sea Eagle, *Haliæetus albicilla;* but the variations in number of metathoracic hairs and in other particulars make it desirable to distinguish the forms from the American bird by a varietal name. The descriptions and figures of Nitzsh, Denny and Piaget differ from one another with regard to the shape of the head, number of metathoracic hairs, etc., to a surprising degree, in view of the fact that all the specimens examined were from the same bird species.

Var. *amblys* Kellogg. Males, females, and young from the Bald Eagle, *Haliæetus leucocephalus* (Lawrence, Kansas). Male, body, length 1.56 mm., width .60 mm.; head, length .47 mm., width .46 mm. Female, body, length 2 mm., width .75 mm.; head, length .52 mm., width .53 mm. Characters of the species as described by Piaget (Supplement, 1885, p. 18, pl. ii, fig. 7), but with head not longer than wide, eyes with a hair, prothorax with a long hair in each posterior angle, metathorax with a spine in each lateral angle and six long hairs on each lateral fourth of the posterior margin.

Nirmus fuscus Nitzsch. (Plate lxvii, fig. 7.)

Zeitschr. f. ges. Naturwiss. (ed. Giebel) 1861, vol. xvii, pp. 523–525.

Nirmus fuscus N., Denny, Monograph. Anoplur. Brit., 1842, p. 118, pl. ix, fig. 8; Giebel, Insecta Epizoa, 1874, p. 123, pl. viii, fig. 2; Piaget, Les Pediculines, 1880, p. 130, pl. x, fig. 9.

Specimens of a large variety of this *Nirmus* of the Eagles and Hawks from Swainson's Hawk, *Buteo swainsoni;* from the Marsh Hawk, *Circus hudsonius;* and from the American Roughlegged Hawk, *Archibuteo lagopus sancti-johannis*—all from Lawrence, Kansas. The American form of *fuscus* (if it be not a new species, indeed) differs markedly from the European type or any of its rather many varieties by being much larger, my specimens being fully one-third larger than the *fuscus* specimens taken from *Buteo vulgaris* by Nitzsch and Piaget. If the various species of Giebel, *fuscus*, *stenorhynchus* and *leucopleurus* (Insecta Epizoa, pp. 124, 129), be only varieties of *fuscus* as Piaget believes (Les Pediculines, p. 131), then *fuscus* has been taken from *Buteo vulgaris*, *Milvus ætolius*, *Falco brachydactylus*, *Parus cœrulens!*, *Aquila nævia*, *Circus rufus*, *Milvus ictinus*, *Ardea gularis!* (Piaget), *Archibuteo lagopus*, *Circus cyaneus*, *Circus æruginosus* and *Milvus regalis.* If in addition *rufus* N. with its numerous varieties belongs to the same species, nine or ten more hawk hosts should be enumerated. Without doubt this *Nirmus* type (elongate, with circumfasciate head, broad transverse median abdominal blotches, and distinct lateral bands with the segmental parts passing the sutures) is not yet at all understood. My specimens show the sharp, narrow emargination of the anterior margins of the first and second median abdominal blotches, which has been given as characteristic of *rufus* N. In size, however, the American specimens are distinct from any of the Old World members of the *fuscous* group. The female specimen I figure is from a Marsh Hawk, *Circus hudsonius*, and measures: Body, length 2.4 mm., width .62 mm.; head, length .6 mm., width .5 mm.

LIPEURUS.

Lipeurus introductus n. sp. (Plate lxviii, figs. 1 and 5.)

Six females, two males, and an immature specimen from a Silver Pheasant, *Phasianus nycthemerus*, received by the Department of Zoology of this University from Mr. A. C. Robison of San Francisco. This Old World pheasant was introduced into America some years ago and it is now breeding wild in parts of the country. This *Lipeurus* species is of the type of *variabilis* N. (Giebel, Insecta Epizoa, p. 219, pl. xvi, fig. 3; Piaget, Les Pediculines, p. 364, pl. xxix, fig. 4; Denny, p. 164, pl. xv, fig. 6), showing the characteristic median abdominal blotches with concave sides and the striking sexual differences; but despite the fact that Piaget finds *variabilis* an extremely variable form and common to several pheasant hosts, I cannot fairly refer my specimens to this species, because of the much greater size, my specimens being one-third longer than the type forms of *variabilis*, and because of numerous minor differences, such as the definite and characteristic number and arrangement of the long hairs of the metathorax, the presence of a hair on the temporal margins of the head, and the character of the genital blotch of the female.

Description of the female. Body, length 2.8 mm., width .66 mm.; colored and marked like *variabilis;* whitish, with distinct black lateral borders and chestnut median abdominal blotches concave on the sides.

Head, length .66 mm., width .5 mm.; in general like *variabilis*, but without ocular bands, or rather with large, subcircular ocular blotches in place of ocular bands (Giebel found merely "ein schwarzer Punkt" in *variabilis);* temporal margins not bare as in *variabilis*, but with a prickle behind the prominent eye, and a distinct hair and a prickle at the posterior angle.

Metathorax with a single long hair in the apex of the posterior angle, and just inside of this a white space with four long hairs (two in *variabilis).*

Abdomen not wholly bare except in angles, as Piaget's description of *variabilis* says, but with two longitudinal submedian rows of weak hairs, each in a small but distinct clear spot; the characteristic small triangular genital blotch of the female of *variabilis* is wanting, being replaced by a short, broad, oblong blotch which is united to the ventral segmental blotch preceding it, this segmental blotch being united also with the one preceding it.

Male. Body, length 2.5 mm., width .5 mm.; head, length .56 mm., width .4 mm.; with the strangely shaped head of *variabilis*, wider in front of the antennæ than across the temples; distinct black antennal bands, ocular blotches, and borders of posterior angles of temples running along posterior margin and terminating in a subcircular head; trabeculæ (wanting in female) peculiarly slender, finger-like; the great antennæ with large first segment with slender blunt horn-like appendage nearer the base than tip; third segment also appendaged. Metathorax with an additional long pustulated hair on posterior margin on each side, just inside of white space bearing four long hairs. Brown median abdominal blotches broader than in female, separated from the black lateral bands by a narrow whitish space; the strongly chitinized genitalia extending through segments 5–8; broadest in segment 5, tapering in segments 6–7, and uniform, narrow, two-pointed in segment 8.

Lipeurus snodgrassi n. sp. (Plate lxviii, fig. 2.)

A single female specimen of this strongly characterized *Lipeurus* from the Red-backed Rufous Hummingbird, *Trochilus rufous* (Palo Alto, California). This species resembles no other *Lipeurus* at all closely, though in the shape of the head and its peculiar length of forehead, in the short metathorax and heavy abdomen, there is suggested an affinity with *Lipeurus macrocephalus* Kellogg, taken from the Western Nighthawk, *Chordeiles virginianus henryi* (Palo Alto, California). See plate lxviii, fig. 3.

Description of female. Body, length 2.2 mm., width .56 mm.; whitish with sharp, black, rather broad lateral margins on head, thorax, and abdomen; abdomen with oblong, transverse, median, smoky brown blotches.

Head, length .55 mm., width .37 mm.; very long but not slender, and tapering but little; the forehead exceptionally long compared with hind head, the distance from antennæ to frontal margin being greater than from antennæ to occipital margin; front rounded, with lateral margins nearly parallel; suture obsolete; four short hairs on each side on the front or anterior part of lateral margin, and two short hairs in front of the short but distinct uncolored trabeculæ; antennæ rather long, slender; segment 2 longest and very slender, especially at base, segment 3 slightly longer than segment 4, and segment 5 slightly longer than segment 3, segments 3–5 colored, with uncolored distal extremities; eyes small, but slightly produced, and with a hair; temporal margins very slightly convex, with two long hairs; occipital margin straight, bare; lateral margins of forehead and hind head bordered with black, widest on temples, and with uneven inner margin on forehead; the lateral borders of forehead pass the anterior lateral angles but do not run clear across the front, although a clear, slightly colored, even chitin band borders the entire clypeal front; mandibles and œsophageal sclerite distinct, dark brown, and an occipital signature acutely pointed anteriorly showing through from under side.

Prothorox short, quadrangular (that part not covered by the head), with rounding posterior angles and straight posterior margin; without hairs; whitish, with broad black lateral borders. Metathorax short, but little longer than prothorax, broader than long, with diverging sides which are slightly concave anteriorly, and straight, bare, posterior margin; the posterior angles with five long hairs in two groups of two and three, rising from white spaces, the group of two hairs really situated on the outer part of posterior margin; segment white, with broad lateral borders which are widest in posterior angles and extend inward, tapering along the posterior margin, not reaching the middle of the segment; metasternum with a brown median blotch; legs whitish, with distinct blackish border on femora and tibiæ, and annulations on femora; coxæ almost wholly colored, and tarsi brown.

Abdomen elongate, subparallel-sided, with a few longish hairs on dorsal surface; whitish, with sharply marked lateral bands with short sharp irregular inward projecting processes; segment 3–6 with oblong, median, brown blotches, darker on segments 5–6 and not reaching the lateral bands; segment 8 with a narrow angulated or curving transversal black line connecting the lateral bands; segment 9 uncolored or whitish, angularly but not deeply emarginated.

Lipeurus macrocephalus n. sp. (Plate lxviii, fig. 3).

Many specimens taken from a Western Night Hawk, *Chordeiles virginianus henryi* (Palo Alto, Calif.). This species shows an affinity with *Lipeurus hypoleucus* N. (taken by Nitzsch in 1814 from *Caprimulgus europœus*, and first called by him *Nirmus concolor*, and then *N. hypoleucus*, under which name Giebel, Insecta Epizoa, p. 146, pl. viii, fig. 5, and Denny, Monograph. Anoplur, Brit., p. 141, pl. vi, fig. 8, refer to it; and finally correctly removed by Piaget, Supplement, p. 66, pl. vii, fig. 3, to *Lipeurus*) by the general outline, the hairs of the head, and the character of the thoracic segments. The new species differ from *hypoleucus* distinctly, especially in the shape of the head and the character of the signature. Oddly enough Piaget was unable to find a male among his specimens, and among the twenty-seven specimens of the new species taken from the single individual of *Chordeiles* examined there is no male.

Description of female. Body, length 3 mm., width .66 mm.; fuscous, with dark rusty brown lateral bands on abomen and thorax, and distinct occipital and antennal bands of head.

Head, length .65 mm., width .5 mm.; forehead as long as hind head, tapering but little and flatly convex, almost truncate in front; suture distinct, both at margins and behind signature; four short hairs in front of suture, the one next to the most anterior being the longest; behind the suture two longer hairs; and rising from the base of the trabeculæ a long hair from the prominent eye, and two very long hairs and two prickles on the temporal margin; occipital margin flatly concave, nearly straight, bare; antennæ slender, all segments weakly colored, with uncolored tips; trabeculæ small but distinct, uncolored; brownish white, with signature and temples brown, and distinct occipital and interrupted antennal bands blackish brown; the signature is broad and short, obtusely angled behind, and shows a number of small whitish subcircular spots; internal bands (*i. e.* margins of the ventral furrow running anteriorly from the mouth) showing through faintly.

Prothorax quadrangular, a little broader than long, with slightly diverging sides, and straight, bare, posterior margin; no hair in posterior angles; ground color that of the head, with narrow uncolored median longitudinal line forking at anterior end; broad dark rusty brown lateral borders. Metathorax but little longer than prothorax, with diverging sides; lateral margins with a slight but distinct rounding concavity near anterior end; posterior margin straight; posterior angles with three longish hairs, and a group of two on posterior margin near the angle; these two and two of the three in angle pustulated; ground color of segment same as or slightly darker than prothorax, with uncolored median longitudinal line, and lateral irregular dark brown lateral borders, narrower than those of prothorax. Legs long, coxæ elongate, brown, with whitish distal ends; femora and tibiæ concolorous with pale ground color of thorax, with rusty brown marginal markings. Sternal markings composed of rather short, broad intercoxal lines between pro- and meso-legs, connecting with a short, narrow transverse median blotch; on metasternum oblong intercoxal blotches, and a large median blotch longer than wide and pointed posteriorly.

Abdomen elongate, subparallel-sided; segments 1, 7 and 8 short; segment 9 very short; posterior angles of segments with a series of five longish fine hairs arising from very small but distinct pustulations near the posterior margin of each segment; beyond this series at each end and near the posterior margin a longer, stronger hair on larger pustulation; all segments except segment 9 with a broad chestnut brown transverse blotch covering all of the segment; stigmatal spots clear; narrow dark rusty brown lateral bands; sutures uncolored; segment 9 uncolored, with two faint brownish lateral blotches, weakly angularly concave behind, without hairs, except two very short prickles, one on each half of posterior margin,

Lipeurus baculus Nitzsch. (Plate lxviii, figs. 4 and 6.)
Germar's Mag. Entomol., 1818, vol. iii, p. 293.

Pulex columbæ majoris Redi, Opusculorum pars I, sive experimenta circa generationem Insectorum, 1686, pl. ii; Albin, Nat. Hist. Spiders and Other Curious Insects, 1736, pl. xliii.; Schrank, Enumeratio Insectorum Austriæ, 1781; Geoffrey, Hist. abrégée des Insectes, 1762, vol. ii, p. 599.

Pediculus columbæ Linne, Systema Natura, 1767; Fabricius, Systema Entomologiæ, 1775.

Nirmus filiformis Olfers, De Veg. et Anim. Corp., 1817, p. 90; Lyonnet, Rech. s. l'anat. et les met. d. diff. esp. d. insectes, 1832, p. 273, pl. xiii, fig. 10.

Lipeurus baculus Nitzsch, Burmeister, Handbuch d. Entomologie, 1832, vol. ii, p. 434; Denny, Monograph. Anoplur. Brit., 1842, p. 172, pl. xiv, fig. 3; Gurlt, in Mag. f. d. ges. Thierheilk, vol. viii, p. 424, pl. viii, fig.; Nitzsch (ed. Giebel) Zeitschr. f. ges. Naturwiss, 1866, vol. xxviii, p. 379; Giebel, Insecta Epizoa, 1874, p. 216; Piaget, Les Pediculines, 1880, p. 303, pl. xxv, fig. 2; Taschenberg, Die Mallophagen, 1882, p. 123; Giraud, Bull. de la Soc. Ent., 1859, p. 140; Osborn, the Pediculi and Mallophaga affecting man and the lower animals, Bull. No. 7, Div. of Ent., U. S. Dept. of Agric., 1891, p. 38, with fig.

Lipeurus bacillus Nitzsch (ed. Giebel) Zeit. f. ges. Naturwiss., 1861, vol. xviii, p. 305; Giebel, Insecta Epizoa, 1874, p. 215, pl. xvi, figs. 8, 9; pl. xx, fig. 3.

Lipeurus antennatus Giebel, Insecta Epizoa, 1874, p. 213.

Lipeurus angustus Rudow, Zeitschr. f. ges. Naturwiss., 1870, vol. xxxvi, p. 137.

Specimens of this long known parasite of doves and pigeons taken from a domestic pigeon, *Columba livia*. I follow Piaget and Taschenberg in their refusal to recognize as species the numerous variants observed. The definition of this species presents a case similar to that presented by *Lipeurus squalidus* (see discussion of *squalidus*).

I figure the female and head of male, not alone for the convenience of American students, but because the previously published figures of this species are faulty. Piaget figures the male. Osborn's figure, undoubtedly well drawn, is spoiled in the printing. Piaget is in error in attempting to correct Giebel's statement that there are four small clavate appendages on the frontal part of the clypeus. Piaget declares there are but two such appendages; in my specimens there are distinctly four. The female specimen figured by me measures: body, length 2.5 mm., width .37 mm.; head, length .42 mm., width .28 mm.

Lipeurus dissimilis Piaget. (Plate lxviii, fig. 7.)

Les Pediculines, 1880, p. 359, pl. xxix, fig. 1.

Two specimens, one immature, from a Bob-white *Colinus virginianus* (Lawrence, Kansas). Piaget described the species from specimens taken from the same bird species in the Zoological Garden of Rotterdam. My specimens differ from Piaget's description in some particulars. Piaget says, "l'œil nu;" my specimens have a distinct longish hair in the eye; the lateral bands of the abdomen distinctly pass the suture in my mature specimen; Piaget says that the bands do not pass the sutures.

The species may be recognized by its general similarity in form and appearance to *Lipeurus docophoroides* Piaget, of the California Quail (see pl. lxviii, fig. 8). *Dissimilis* differs from *docophoroides* in having the head more rounded in front, the abdomen longer and broader, and in the absence of pustulations at the bases of the hairs. My specimen (mature) measures: Body, length 2.4 mm., width 1.03 mm.; head, length .6 mm., width .53 mm.

Lipeurus docophoroides Piaget. (Plate lxviii, fig. 8.)

Les Pediculines, 1880, p. 357, pl. xxviii, fig. 9.

Two female specimens of this striking *Lipeurus*, taken from a California Partridge, *Callipepla californica* (Mountain View, California). Piaget found his specimens on individuals of the same bird species in the Zoological Garden of Rotterdam. The species is a transition form between *Docophorus* and *Lipeurus*. Piaget says of it: "La forme du thorax, des pattes en général et de l'abdomen, la présence des trabécules indiquent une transition au genre *Docophorus*; l'antenne, la fossette, l'implantation du coxis au bord du thorax, l'étranglement du métathorax, la forme du dernier segment ♂ attachent cette espèce aux *Lipeuri*."

The species may be recognized by its pointed conical head, with black and dark brown bands and markings, by its Docophoroid body, with distinct black lateral bands on thorax and abdomen, and by its whitish ground color and dark chestnut brown transverse lateral blotches, with pustulated hairs and large uncolored stigmatal areas. The specimen figured by me measures: Body, length 1.93 mm., width .78 mm.; head, length .56 mm., width .51 mm.

GONIODES.

Goniodes cervinicornis Giebel. (Plate lxix, fig. 1.)

Insecta Epizoa, 1874, p. 199.

Goniodes cervinicornis G., Piaget, Les Pediculines, 1880, p. 272, pl. xxii, fig. 6.

Numerous specimens from a Silver Pheasant, *Phasianus nycthemerus*, sent to the Department of Zoology of this University by Mr. A. C. Robison of San Francisco, Calif. This large and striking *Goniodes* of the pheasants (Giebel's specimens were found by Kollar on *Phasianus nycthemerus*, and Piaget has found it abundantly on *Tragopan satyrus*) is characterized by the peculiar bipartite appendage on the first segment of the antenna of the male. It may be readily recognized by comparison with the figure of the female which I give. My specimens measure; Male: Body, length 3.34 mm., width 2 mm.; head, length .9 mm., width 1.32 mm. Female: Body, length 3.75 mm., width 2. mm.; head, length 1.03 mm., width 1.34 mm. These measurements are markedly greater than those given by Piaget; his male specimens averaging 2.75 mm. long, and the females 3.1 mm. long.

Goniodes mammillatus Rudow. (Plate lxix, fig. 2.)

Zeitsch. f. d. ges. Naturwiss., 1870, vol. xxxv, p. 483.

Goniodes mammillatus Rudow, Taschenberg, Die Mallophagen, 1882, p. 25, pl. i, figs. 1, 1a, 1b.

Two females from a California Partridge, *Callipepla californica* (Mountain View, California). This striking species was first described by Rudow from a specimen taken from *Pelecanus ruficollis!* (a dried skin in some museum). Taschenberg, who collected a number of specimens from *Callipepla californica* (skins?), says: "Wenn die Art wirklick wie Rudow angiebt, auf *Pelecanus ruficollis* angetroffen ist, so ist es in Folge zufälliger

Uebertragung geschehen." The species may be recognized by the broad abdomen and the striking angulated lateral bands of the abdomen, each segmental portion projecting diagonally forward and inward and ending in an indistinctly limited paling brown blotch. Taschenberg says that the head of the male is a little longer than broad, with deep emarginations at the bases of the antennæ, and with strongly angulated temporal margins between which the head is a little narrower than it is just in front of the antennæ. The female figured by me measures as follows: Body, length 2.25 mm., width 1.16 mm.; head, length .62 mm., width .72 mm.

GONIOCOTES.

Goniocotes creber n. sp. (Plate lxix, fig. 3.)

An extraordinary number of specimens on a Silver Pheasant, *Phasianus nycthemerus*, presented to the Department of Zoology of this University, by Mr. A. C. Robison of San Francisco. In addition to the great number of individuals of this *Goniocotes* on the bird, there were present in more than ordinary numbers the giant *Goniodes cervinicornis*, *Lipeurus introductus* n. sp. and *Menopon monostæchum* n. sp. The short feathers of the neck, especially of the throat, were literally covered with the eggs of some one of these species. This *Goniocotes* resembles in general characters Giebel's species *chrysocephalus* (Insecta Epizoa, p. 189), a common *Goniocotes* of Pheasants, found so far on *Phasianus colchicus*, *nycthemerus*, *sommeringii*, *pictus*, and *Euplocamus ignitus*, but is a markedly larger species.

Description of the female. Body, length 1.6 mm., width .87 mm.; pale yellowish brown, with darker head and with dark brown head markings, and lighter lateral bands which are peculiarly curved so as to enclose a less chitinized space.

Head, length .44 mm., width .6 mm.; front broad, convex, with ten short prickles; antennæ in a shallow emargination with second segment longest and the fifth longer than third or fourth, which are about equal; eye prominent, with a prickle; the slightly protruding, rounded temporal margins with a prickle and two strong hairs; posterior margin concave in middle, with obtuse angles at each end of the concavity; head brownish, with darker narrow marginal frontal bands ending posteriorly on each side in an expanded darker spot inside of antennal emargination; mandibles and œsophageal sclerite dark brown; an irregular brown ocular blotch and a sinuous dark brown occipital border along the concave curve of the occipital margin.

Prothorax very narrow, short, trapezodial, with lateral margins converging anteriorly, and posterior margins flatly convex; the latero-posterior angles are slightly produced and acute, and each bears a strong hair; indistinct brownish lateral borders. Metathorax with blunt lateral angles, each with two strong hairs; posterior margin obtusely angled on abdomen, and bare except for two hairs near the lateral angles. Legs concolorous with body, with dorsal marginal markings and some scattered spines.

Abdomen broadly elliptical; posterior angles of segments projecting and bearing, except on segment 1, one to three rather short, strong, finely pointed hairs; segment 1 longest at sides but short in middle because of the backward projecting angulated thorax; middle region of abdomen pale to uncolored, faint lateral transverse blotches and conspicuous lateral bands, which on all segments except segment 1 are curved so as to enclose a small uncolored space; the curved band projects inward and forward, passing the suture; the last segment flatly rounded behind, with a slight angular emargination, the margin bordered by a narrow uncolored space.

Male. Body, length 1.15 mm.; width .7 mm.; head, length .34 mm., width .47 mm.; abdomen as wide as long, suborbicular; median uncolored region of abdomen relatively larger than in female; lateral transverse blotches no more distinct than in female, but lateral bands more strongly chitinized; posterior margin of abdomen broad, straight, with projecting rounded ninth segment in the middle; posterior border of ninth segment colored, the margin with a few short strong hairs; genitalia extending far forward.

Goniocotes compar Nitzsch. (Plate lxix, fig. 4.)

Germar's Mag. Entomol., 1818, vol. iii, p. 294.

Pediculus bidentatus (?) Scopoli, Ent. Carn., 1763, p. 385.

Philopterus compar Nitzsch, Walckenær, Hist. Nat. Ins. Apt., 1844, vol. iii, p. 358.

Goniocotes compar Nitzsch, Burmeister, Handbuch d. Ent., 1835, p. 431; Gurlt, Mag. f. d. ges. Thier., 1842, vol. viii, p. 117, pl. iv, fig. 2; Denny, Monograph. Anoplur. Brit., 1842, p. 151, pl. xiii, fig. 2; Giebel, Zeitsch. f. ges. Nat., 1861, vol. xviii, p. 305; l. c., 1866, vol. xxviii, p. 389; Giebel, Insecta Epizoa, 1874, p. 183, pl. xii, fig. 8; Piaget, Les Pediculines, 1880, p. 284, pl. xix, fig. 10; Taschenberg, Die Mallophagen, 1882, p. 69; Osborn, The Pediculi and Mallophaga Affecting Man and the Lower Animals, 1891, Bull. 7, Div. of Ent., U. S. Dept. Agri., p. 33, fig. 19.

Specimens taken from a Domestic Pigeon, *Columba livia* (Lawrence, Kansas). This well known *Goniocotes* of the Domestic Pigeon has been found by Piaget on *Columba palumbus* and *C. phasianella*, and by Denny on *Columbus œnas*, *C. palumba* and (a variety, Denny thinks) on *C. turtur*, as well as on the various races of the domestic pigeon. It is a small form, only about 1 mm. long, whitish, with a pale brownish border along the lateral margins of the abdomen and thorax; the temples are angled and bear two very long backward-projecting hairs. The posterior margin of the metathorax is angulated and the angle projects so far backward that it nearly cuts the first abdominal segment in two. Professor Osborn's figure is faulty in representing the metathorax with straight posterior margin. The male figured by me measures: Body, length 1.06 mm., width .48 mm.; head, length .34 mm., width .37 mm.

PHYSOSTOMUM.

Physostomum microcephalum n. sp. (Plate lxx, fig. 1.)

A single female from the House Finch, *Carpodacus mexicanus frontalis* (Palo Alto, California). Not common on its host, as I have a record of twelve other individuals of *Carpodacus* from which Mallophaga were taken, but on none of them was this *Physostomum* again found. The new species approaches the general type of *P. agonum* N. (Giebel, Insecta Epizoa, p. 255), from *Sylvia rubecula* and *S. suecia* more nearly than it approaches any other of the Old World species.

Description of female. Body, length 3.6 mm., width 1.25 mm.; head small; abdomen large and exceptionally broad; head markings pale, ill-defined; distinct brown lateral bands; paler colored large median transverse abdominal blotches.

Head, length .66 mm., width .72 mm., thus being wider then long, which is exceptional in *Physostomum*, and being especially small in proportion to the size of the whole body; front flatly rounded, and sides of forehead weakly concave; prickles on front, one hair on margin at extremity of transverse clypeal suture, and a few very short hairs and two longer ones along margin before the eye; eye distinct, with a black fleck; palpi passing the margins of head; the blunt lateral flaps slightly passing the margin; temples not produced very far backward, with a little narrowed tip at the apex of the posterior angle; temporal margins with three longish hairs and a few short ones; markings weakly colored, a pale chestnut brown.

Prothorax, with distinct lateral angles, in apex of which a spine and a long hair; another long hair near rounded posterior angle, and two spines on margin in front of lateral angle; segment whitish, with faint brownish tinges on lateral borders and elsewhere. Metathorax with weak concavity on lateral margins in front of the middle; two hairs in the posterior angles, and some scattered short spines on margin and dorsal surface of anterior half (mesothorax) of segment; color of prothorax, with brown lateral borders narrowing anteriorly. Legs concolorous with thorax, with narrow darker marginal color.

Abdomen large, expanding in the middle half, and broad and bluntly rounded behind; not very long single hairs in the posterior angles, and on the dorsal surface just inside of the colored lateral bands a double longitudinal row of weak hairs; whitish, with distinct brown lateral bands and large oblong median abdominal blotches, darkest on segments 5 and 6.

Physostomum sucinaceum n. sp. (Plate lxx, fig. 2.)

Three females from a Western Flycatcher, *Empidonax difficilis* (Palo Alto, California). A small *Physostomum*, the smallest I have taken.

Description of female. Body, length 2.84 mm., width .81 mm.; ground color pale amber instead of whitish, as is usual with *Physostomum;* brownish lateral bands, and head markings not strongly colored.

Head, length .53 mm., width .5 mm.; front rounded, with usual few hairs; palpi short, barely passing the margins of head; temples produced backwards and acutely angled with three longish hairs and some short ones;

clypeus clear, almost uncolored; head markings dark brown, but not very sharp; eye with black fleck.

Prothorax with almost no lateral angles, the angles being very obtuse and flattened; two spines and a long hair in the angles and another long hair near the posterior angle; posterior margin of segment concave; a brownish submarginal lateral border. Metathorax with a few small spines along lateral margins, and a longish hair near posterior angles. Legs whitish, paler than body color.

Abdomen with sides only flatly convex, subparallel; single hairs on posterior angles of segments and a longitudinal row of small hairs, one on each segment, on each side inside of the lateral band; lateral bands pale amber brown, not much darker than ground color of body; faint median transverse blotches, apparently nearly square.

Physostomum angulatum n. sp. (Plate lxx, fig. 5.)

Two females taken from a Kingbird, *Tyrannus tyrannus* (Lawrence, Kansas), and one female from a Fox Sparrow, *Passerella iliaca* (Lawrence, Kansas).

Description of female. Body, length 5. mm., width 1.3 mm.; pale golden, with narrow dark brown lateral bands on abdomen and thorax, and few dark brown head markings; the largest *Physostomum* yet found.

Head, length 1 mm., width .94 mm.; front flatly convex, without marginal hairs, sides with two short hairs on dorsal surface near and projecting over the margin even with base of antennæ, and at same place two similar submarginal ventral hairs, and two shorter hairs on margin in the very slight ocular emargination; occipital angles acute and much produced posteriorly (extending nearly to middle of prothorax), bearing three long hairs; occipital margin is thus very concave and is without hairs; palpi projecting beyond margin by half of last segment;

labral lobes inconspicuous, not projecting beyond margin of head; a distinct, curved, dark brown blotch bounding inner margin of antennal fossa; in front of it two paler blotches, the anterior being the larger, and a narrow dark brown occipital border; the rest of head concolorous with the body or paler.

Prothorax hexagonal, the angles rounded, the lateral angles with a longish weak hair and a spine; a distinct, brown, submarginal border laterally, which turns inward at its anterior end and is looped. Metathorax longer than prothorax, with gently sinuous sides, without distinct marginal hairs (a short projecting hair or spine near the posterior angle is not strictly marginal); posterior margin straight; anterior angles with irregular brown blotch, a linear, diagonal blotch on each side near middle, and submarginal lateral bands continuous with those of the abdomen. Legs long, slender; concolorous with the body.

Abdomen elongate-elliptical, truncate anteriorly, with sharply marked dark brown to black submarginal lateral bands composed of segmental parts separated by diagonal sutures and slightly laterally displaced; posterior angles of segments with one or two weak hairs; vulva convex.

Physostomum australe n. sp. (Plate lxx, fig. 4.)

One female from a Western Nonpareil, *Passerina versicolor* (Cameron County, Texas), resembling *angulatum* in marking but smaller and head comparatively shorter and narrower anteriorly, hence more tapering; with abdomen with median blotches which are wanting in *angulatum*.

Description of female. Body, length 4 mm., width 1.06 mm.; almost uncolored, with yellowish tinge strongest on head and thorax; with sharp black lateral markings and pale brown median abdominal blotches.

Head, length .68 mm., width .7 mm.; front narrow, flatly convex, without hairs; sides with a distinct rounding emargination even with the mouth parts; ocular emargination filled by the conspicuous eye; occipital angles not so acute as in *angulatum*, but projecting backwards nearly to lateral angles of prothorax, and with three longish hairs. Markings similar in position to those of *angulatum* but more pronounced; antennal fossa entirely rimmed and connected with occipital border by a short occipital band; in front of the antennal fossa three blotches (instead of two as in *angulatum*), the most anterior being a short band projecting inward from the lateral margin.

Prothorax with the constriction in front of lateral angles especially marked and the angles with one or two spines but no hair; general color of the segment golden brown, with black submarginal lateral bands. Metathorax with a rounded swelling on anterior third of sides, without marginal hairs and with markings resembling those of *angulatum*, viz., irregular black blotches in anterior angles, submarginal lateral bands continuous with those of abdomen, and two short linear blotches lying inside of the lateral bands which are in this species entirely disconnected from the bands and are but slightly diagonal. Legs pale with distinct narrow black margins on femora and indistinct narrower tibial margins.

Abdomen; segments with one long hair on lateral margin near posterior angle; posterior margin of last segment with hairs composing the delicate fringe unusually long; uncolored to pale golden, with uniform submarginal lateral black bands (more nearly continuous than in *angulatum*, the diagonal sutures and lateral diplacement of the various segmental portions being less marked);

on segments 1–7 a pale brown median blotch, the blotches on segments 4–5 being larger; vulva convex.

Physostomum diffusum n. sp. (Plate lxx, fig. 3.)

One female taken on the Sandwich Sparrow, *Passerculus sandvicensis*, and several males and females taken on the Golden Crown Sparrow, *Zonotrichia coronata* (near Stanford University, Calif.); also two females and a young specimen (variety *pallidum* Kellogg) from a *Junco* sp. (Lawrence, Kansas). This species differs from the preceding two species described in having the lateral abdominal bands distinctly marginal (as is the case with the species of Piaget, Nitzsch, and Denny), and in this it resembles the European species. It has the very long, backward-projecting, occipital angles, as in *angulatum* and *australe*, which is a character shown by but few of the European forms.

Description of female. Body, length 4 mm., width 1.09 mm.; white, with dark brown to black marginal lateral bands on abdomen and thorax, and few black head-markings; the labral lobes large and projecting.

Head, length .8 mm., width .7 mm.; front rather broad, flatly convex, without marginal hairs, sides nearly straight but slightly constricted even with the projecting labral lobes; a single projecting submarginal hair near middle of head, with a very short hair barely reaching margin close to it; in the small ocular emargination several short hairs; occipital angles acute, with two long hairs; the palpi barely project beyond the lateral margin of the head but the labral lobes are large and project conspicuously beyond the margin; markings consisting of a small black ocular fleck, a dark brown blotch on inner margin of antennal fossa, and in front of it two smaller blotches, the anterior the least distinct; a narrow, interrupted, smoky, occipital margin, indications of occipital bands, and a narrow, indistinct smoky margining of the temples.

Prothorax hexagonal, with anterior and posterior margins weakly concave; in the obtuse lateral angles a hair and two spines; segment white with a narrow submarginal black band, the margin outside of it being more or less suffused with smoky brown. Metathorax with a slight lateral swelling on the lateral margin near the anterior end, bearing a few short pale brown spines; in the posterior angles a single, longish, weak hair; segment white, with a narrow, submarginal, lateral band, outside of which on posterior half of segment the margin is smoky brown. Sternal markings consisting of an intercoxal line, long and curving forward, on metasternum, and two faint median lines on prosternum. Legs, white.

Abdomen. Posterior angles with a single longish hair and a shorter weaker one on lateral margin of each segment of segments 5–8; last segment flatly rounded with two pairs of hairs, and the posterior fringe distinct; dorsal surface without hairs, or with very few; segments white, with broad, black, marginal, lateral bands fading out on eighth segment; indications of narrow, transverse, linear, median blotches at the sutures; under side of abdomen with pale brown, median blotches on segments 5–6.

Var. *pallidum* Kellogg. Two females and a young specimen taken from a *Junco* sp. (Lawrence, Kansas) may be referred to this species but they show varietal differences. The body color is pale golden, the markings are brown, not black, and the middle region of the whole abdomen is pale brownish; of the head markings only the ocular fleck and the bounding blotch on inner rim of the antennal fossa are distinct.

COLPOCEPHALUM.

Colpocephalum chrysophæum n. sp. (Plate lxxi, fig. 1.)

Found on three out of seven specimens of Samuels' Long Sparrow, *Melospiza fasciata samuelis* (Palo Alto, California).

Description of female. Body, length 1.35 mm., width .7 mm.; golden brown with blackish brown bands and margins, and rusty brown transverse blotches.

Head, length .28 mm., width .5 mm.; broadly parabolic in front; one short hair on each side of the middle, then a longer one, then a short one, then a very long one, then two longish ones; the palpi project by at least the last two segments; the ocular emargination is distinct but not acute inwardly; the eye is large, emarginate, and with a distinct black fleck; ocular fringe distinct; temples projecting, rounded, rather narrow, with several long hairs of different lengths, of which two are very long and equal; on the occipital margin of the temples another very long hair and two or three shorter ones; middle part of occipital margin with a few long hairs; head tinged with fuscus with black, curving, broadly linear, ocular blotch and narrow curving transversal black line subparallel with frontal margin of clypeus; occipital and inner bands forming a brownish H in middle of head, the lines being broad and slightly curving; in the anterior part of the H a brown blotch, and a tapering brown triangle projecting backward from the cross bar of the H; four small pale to uncolored circular spots, one at each end of the cross bar of the H, and the two others outside of but contiguous to the anterior legs of the H.

Prothorax broad, short, with a strong hair in the lateral angles and two spines, and ten longish hairs ranged along the posterior margin; the transverse chitinized bar is especially narrow and distinct, and the curving longitudinal lines beyond the ends are sharply defined and black. Metathorax with posterior margin straight and with about ten longish weak hairs ranged along it; darkest along the short anterior margin and in the latero-posterior angles. Legs pale, with sharply defined marginal markings, especially on the coxæ and on the long slender tibiæ of middle and hind legs. Sternal markings consisting of a small median triangle with linear wings on prothorax, and of black, distinct, angulated, intercoxal lines between meso- and meta-coxæ.

Abdomen ovate, broad at both ends; long hairs in posterior angles of segments, and short hairs, not numerous, on dorsal surface; all segments with a broad, brown, transverse blotch extending entirely across segment, covering almost the whole surface; the sutures, however, are broad and uncolored; lateral bands narrow, black, fading inwardly into the transverse blotches; last segment broad, flatly convex behind, with a fringe of short hairs.

Male. Body, length 1.09 mm., width .5 mm.; head, length .25 mm., width .4 mm.; conspicuously smaller than the female; genitalia extending through segments 5–9, in shape a heavy two-pronged fork.

Colpocephalum osborni n. sp. (Plate lxxi, figs. 2 and 3).

Many specimens, males, females and young, from a White-tailed Kite, *Elanus glaucus* (Palo Alto, California), resembling *C. dissimile* Piaget (Les Pediculines, p. 520, pl. xliii, fig. 4), taken from *Milvus ægyptius* (Museum of Leyden), and *C. tricinctum* Nitzsch (Giebel, Insecta Epizoa, p. 263), taken from *Milvus ater*. Named for Prof. Herbert Osborn of Iowa, who has contributed to the knowledge of American Mallophaga.

Description of male. Body, length 1.31 mm., width

.5 mm.; golden brown, with distinct, broad, black, occipital bands with expanded extremities, and dark brown, transverse, abdominal blotches with black lateral ends.

Head, length .31 mm., width .5 mm.; rather large compared with whole body, just as wide as widest part of abdomen; front broad, flatly rounded, with seven hairs on each side of the median line, four of which are grouped together in front of the ocular emargination; last segment of antenna broad, with slightly concave terminal margin projecting beyond margin of head; ocular emargination pronounced, the deepest point being acutely angled; an ocular fringe; swelling rounded temporal margins, with several hairs of different lengths, three being about equal and longest; occipital margin concave, with four hairs; golden brown, with large black subcircular ocular blotches and triangular occipital blotches connected by the broad, paler (reddish brown) occipital bands; the occipital blotches connected by an even, strongly colored, broad, occipital border; clypeus with two blackish brown blotches connected with the ocular blotches and mandibles by colored areas but little darker than the ground color of head.

Prothorax short, extending laterally even with the outer margin of the occipital blotches of the head, with a hair and spine in each lateral angle, and eight hairs along the flatly convex posterior margin; concolorous with ground color of head. Metathorax short, with flatly convex posterior margin, bearing a series of short, weak hairs; a transverse chestnut-brown blotch across posterior half of segment, expanding and darker at lateral ends. Legs with distinct dark brown markings.

Abdomen bluntly elliptical, third segment widest, with segments projecting but little laterally; many short hairs along sides and on dorsal surface; segments 1–8 with broad, transverse, dark chestnut-brown blotch entirely across segment, darkest laterally, with sharp black angulated lateral bands, especially noticeable on segments 3–8; last segment without noticeable blotch, bluntly rounded behind, without numerous hairs.

Female. Body, length 1.47 mm., width .63 mm.; head, length .3 mm., width .5 mm.; with abdomen obovate, tapering posteriorly; abdominal blotches darker laterally but paler in the middle; lateral bands not angulated and wider; last abdominal segment elongate, tapering, with narrow flatly convex posterior margin; segment 8 with a group of seven strong curving hooklike hairs, the posterior ones longest, situated on posterior part of lateral margin of segments; posterior margin of this segment with a series of closely set hairs.

Colpocephalum fumidum n. sp. (Plate lxxi, fig. 5.)

A single specimen from a Least Bushtit, *Psaltriparus minimus* (Palo Alto, California). A strikingly dark *Colpocephalum* showing resemblance to some of the *Colpocephali* of the water birds, such as *uniseriatim* Piaget (Les Pediculines, p. 562, pl. xlvii, fig. 2), from an Avocet, *Recurvirostra avocetta*, rather than to any of the few *Colpocephali* hitherto described from passerine birds.

Description of female. Body, length 2.75 mm., width 1.1 mm.; very dark, smoky, with black occipital margin, ocular blotches, and blackish lateral abdominal bands.

Head, length .5 mm., width .75 mm.; forehead large, flatly rounded in front, with numerous short hairs; two longer hairs in angle in front of ocular emargination; the ocular emargination pronounced, angulated, with the anterior margin of the produced temples almost at right angles to the long axis of the head; the eye prominent, almost if not quite divided, the anterior and larger part lying in the angle of the emargination, the smaller and posterior part lying apparently on the dorsal surface of the temple; ocular fringe distinct, composed of longish hairs; temporal margins with slightly rounded anterior and posterior angles, and slightly convex lateral margin which bears five longish hairs; occipital margin weakly sinuous and concave, with four hairs; fuliginous with black uneven occipital border; small black ocular blotches, and four small circular uncolored spots on forehead, from each of which arise one or more hairs.

Prothorax with bluntly rounded lateral angles, slightly concave latero-posterior margins, and convex posterior margin, the segment produced backward so as to very materially narrow the median part of the mesothorax, with a spine and a long hair in the lateral angles and two separated hairs on the concave lateral margins, the anterior hair being short and weak. Mesothorax separated from metathorax by an uncolored suture, but with extremely slight lateral emargination; no hairs. Metathorax larger than mesothorax, with straight posterior margin, a spine, a weak hair and a strong hair in posterior angles, and posterior margin not with a marginal series of hairs; all the thoracic segments very dark, the ground color same as that of head and darker than that of abdomen; the lateral borders darkest. Legs concolorous with body, robust.

Abdomen long-ovate, segments of equal lengths, a few long hairs in posterior angles, and dorsal surface with posterior margins of segments with single series of hairs set in faint pustulations; ventral surface with series of short fine hairs in small but distinct pustulations; last segment narrowly, flatly convex, with a fringe of fine uncolored hairs; whole abdomen smoky but lighter than head and thorax; black lateral bands paling inwardly.

Colpocephalum flavescens Nitzsch. (Plate lxxi, fig. 4.)
Germar's Mag. Entomol., 1818, vol. iii, p. 298.

Colpocephalum flavescens N., Nitzsch (ed. Giebel) Zeitschr. f. ges. Naturwiss, 1861, vol. xvii, p. 522; Burmeister, Handb. d. Ent., 1835, vol. ii, p. 438; Denny, Monograph., Anoplur. Brit., 1842, p. 206, pl. xviii, fig. 2; Giebel, Insecta Epizoa, 1874, p. 262, pl. xiii, fig. 10; Piaget, Les Pediculines, 1880, p. 515, pl. xlii, fig. 10.

Specimens which should probably he referred to this species from two Bald Eagles, *Haliæetus leucocephalus*, and an American Rough-legged Hawk, *Archibuteo lagopus sancti-johannis* (Lawrence, Kansas). The male figured by me measures: Body, length, 1.5 mm., width, .6 mm.; head, length .31 mm., width .53 mm. The species may be recognized by the strong distinct blotches and occipital bands and border of the head, and the transversal abdominal blotches.

Colpocephalum subæquale Nitzsch. (Plate lxxii, fig. 1.)
Germar's Mag. Entomol., 1818, vol. iii, p. 299.

Colpocephalum subæquale N., Burmeister, Handb. d. Ent., 1835, vol. ii, p. 438; Giebel, Insecta Epizoa, 1874, p. 265, pl. xiii, figs. 13 and 14, Piaget, Les Pediculines, 1880, p. 527.

Two females from an American Crow, *Corvus americanus* (Palo Alto, California). I did not find this species represented on several other crows shot at Palo Alto and at Lawrence, Kansas, although all of the individuals were infested by other parasites, such as *Docophorus atratus* or *Menopon mesoleucum*. My specimens do not have the dorsal surface of the thoracic segments with scattered long hairs, nor the surface of the abdomen thickly beset with hairs, as Giebel's description (Insecta Epizoa, p. 265) records; but neither are these hairs shown in Nitzsch's figure. Nitzsch's specimens were found on *Corvus corax* and *C. frugilegus*. My specimens do not have the first two segments of the abdomen especially lengthened as in Rudow's *semicinctum* (Zeitschr. f.

ges. Naturwiss., 1869, vol. xxxiv, p. 394), from *Corvus scapulatus.* The species may be recognized by the broad black occipital border and occipital bands, ocular and frontal blotches of the head, and by the transverse abdominal blotches of the abdomen, much narrowed in the middle in the male, and divided in the female into a median and two lateral parts. The female figured by me measures: Body, length 1.53 mm., width .63 mm.; head, length .31 mm., width .5 mm.

Menopon decoratum n. sp. (Plate lxxii, fig. 2.)

One male, one female, and a young specimen from a White-tailed Kite, *Elanus leucurus* (Palo Alto, California). A finely marked species not resembling especially any other *Menopon* hitherto taken from birds of prey. No *Menopon* has heretofore been taken from a Kite.

Description of male. Body, length 1.53 mm., width 72 mm.; pale yellowish brown, with dark rusty brown to black markings; distinct transverse bars on abdominal segments, the one on segment 2 especially strongly defined.

Head, length .31 mm., width .66 mm.; robust, more than twice as wide as long; front broad, flatly rounded, with a few short weak hairs, and on the weak swelling in front of the shallow ocular emargination two strong hairs, of which one rises from the dorsal surface; temples expanded, with two longish hairs and three very long ones; occipital margin concave, straight in the middle, with four long hairs; large black ocular fleck; an irregular blackish brown ocular blotch (on base of antennal band), the two connected by a paler curving transverse band, and also connected with the occipital margin by pale, broad, ill-defined occipital bands, the bases of the bands being blackish brown; on the forehead in front of mandibles a pale, short, curving band on each side.

Prothorax irregularly hexagonal, with obtuse lateral angles, and posterior margin flatly convex, with a very obtuse median angle; lateral angles with one very long hair and one shorter one, and a series of eight strong hairs along posterior margin, the terminal hair at each end of the series being exactly in the latero-posterior angle; chitinized tranverse bar in anterior part of segment is weakly colored, and the longitudinal bars at its end are indistinct. Metathorax as short as or slightly shorter than prothorax, wider, with posterior margin straight; two long hairs in posterior angles, and a series of shorter weak ones along posterior margin; anterior angles with strongly colored blotch; an ill-defined, short longitudinal blotch projecting back from converging lateral margins. Legs palely colored.

Abdomen broadly ovate, wide and flat behind; posterior angles of segments with two usually long hairs and several short ones; single series of hairs not numerous on dorsal surface; lateral bands blackish brown, broad, interrupted, the segmental portions projecting inward; dark chestnut brown transverse blotches across the segments, with the pale or uncolored sutural bands broad; the colored transverse band of segment 2 is specially strongly marked, and is rather sinuous; last segment with broad, uncolored, posterior border, and with posterior margin straight, with a slight median emargination, and a sparse fringe of hairs of different lengths.

Female. Body, length 2. mm., width .94 mm.; head, length .4 mm., width .7 mm.; perhaps a little darker; the transverse blotches of abdomen better defined; last abdominal segment narrower than in male, and the posterior margin broadly parabolic, with few long, and numerous short hairs.

Menopon robustum n. sp. (Plate lxxii, fig. 3.)

A single specimen found on a Least Bush Tit, *Psaltriparus minimus* (Palo Alto, Calif.). No other specimens of this strange species were found on five other individuals of the same bird species examined. I refer the species to the genus *Menopon*, for it is evidently more closely allied to this genus than to any other one so far established. But it presents a mingling of characters of *Menopon*, *Ancistrona* and *Eureum;* a short broad head with strongly chitinized backward-projecting processes on the ventral surface like *Ancistrona;* a thorax like *Eureum*, and the habitus and general body characters of *Menopon*. If it is to be referred to *Menopon* it ranks with *titan* and *tridens* as anomalous members of the genus, which should be distinguished by subgeneric names, or which should be the provocation for breaking up the already unwieldy genus into several genera. In general shape it resembles *M. subrotundum*, Piaget (Les Pediculines, p. 453, pl. xxxv, fig. 2), from *Gracula sulcirostris*.

Description of the female. Body, length 1.43 mm., width .85 mm.; being thus very broad and short; smoky translucent brown, with broad, transverse, abdominal bands, darker on the lateral margins; head with no well defined bands or blotches except the small ocular flecks; labial projections of under side showing through; head with very long hairs.

Head, length .25 mm., width .6 mm.; very broad and short, crescentic, with narrow rounded ends; front with one very short hair on each side of middle, then two short ones and then three long hairs, the hindmost two being in the lateral angle just in front of the ocular emargination; palpi short, not reaching the margin; the emargination small but distinct, with the eye large, nearly divided, and with a distinct fleck; the narrow produced temples with five long hairs of which the hindmost three are very long; occipital margin with six hairs, the two outer ones arising submarginally, no distinct head bands or blotches; the occipital margin narrowly bordered with black; on the under side of the head there are two strongly chitinized, backward-projecting, pointed processes arising from the labium (resembling those, but not bipartite, of *Ancistrona*); these processes show through above and give an appearance of faint occipital bands.

Prothorax very large, as long as the head, and three-fourths as broad, with strong, produced, obtuse, lateral angles; posterior margin obtusely angled on the metathorax; a strong spine and a long hair in each lateral angle, and a not well filled series of weak hairs along posterior margin; the transverse chitin bar distinct, blackish brown, and the curving longitudinal chitin bars at its ends distinct, blackish; no well defined blotches. Metathorax with a few small spines along lateral margins and two longish hairs in posterior angles; posterior margin with marginal series of short hairs (like those of abdomen); regions of latero-posterior angles dark brown, the color extending forward narrowly along the lateral margins. Sternal markings composed of a small median blotch on prothorax, with posterior produced point and lateral linear processes; curving intercoxal lines on mesothorax and short straight ones on metathorax, with a broad pale colored median blotch. Legs concolorous with head and thorax, with coxæ distinctly margined with blackish brown; anterior coxæ with blunt processes about as long as but narrower than the coxæ themselves.

Abdomen more golden or yellowish brown than head and thorax; very broadly elliptical; but slightly turbinated; with two or three rather short hairs in posterior angles; a single transverse series of short hairs along posterior margin of each segment; broad, transverse bands entirely covering each segment; darker at lateral margin, especially on anterior segments; last segment flatly rounded, with fringe of short hairs.

Menopon monostœchum n. sp. (Plate lxxii, fig. 4.)

Specimens from a Silver Pheasant, *Phasianus nycthemerus*, received by the zoological department of this University from Mr. A. C. Robison of San Francisco, California.

The species is like *subæquale*, Piaget (Les Pediculines, p. 463, pl. xxxvii, fig. 5), from *Euplocamus ignitus* in shape of thorax and body, but has only single series of hairs on the abdominal segments (*subæqualæ* has two series on each segment); in the matter of the hairs of the body the new species is like *uniseriatim*, Piaget (Les Pediculines, p. 464, pl. xxxviii, fig. 4) from *Phasianus prælatus*, but differs from this species in not having the posterior margin or prothorax projecting backward and angulated; in both *subæqualæ* and *uniseriatim* the females are smaller than the males (according to Piaget), which unusual condition does not obtain in the new species.

Description of the male. Body, length 2.06 mm., width .9 mm.; whitish, with faint brownish tinge; with inconspicuous but distinct markings of blackish brown and chestnut; with numerous long hairs.

Head, length .41 mm., width .7 mm.; front rounded, with indication of median angulation; with about ten marginal hairs of different lengths in front of the ocular emarginations, which are shallow but distinct; palpi projecting; the projecting temporal margins with several long hairs, of which two are very long; occipital margin concave, with eight long hairs; a black ocular fleck and brown ocular blotch; occipital margin narrowly edged with brown; mandibles and adjacent lateral regions dark chestnut brown.

Prothorax with lateral angles narrowly rounded, and with a longish spine; posterior margin curving at sides, but nearly straight on metathorax, and with a marginal series of strong, long hairs; transverse chitin bar pale to uncolored, but distinct, as also the longitudinal bar at its ends. Metathorax of about same length as prothorax, and but very little if at all wider; with five strong, short spines along each lateral margin, and a series of hairs along the straight posterior margin; lateral margins narrowly bordered with blackish brown, and linear brown blotches projecting backward from anterior angles, and tapering and fading out posteriorly. Legs pale, concolorous with body.

Abdomen elliptical, with segments projecting but little laterally; posterior angles with several hairs of different lengths, the hairs longer on posterior segments until on segments 8–9 some of them are very long; lateral bands with short processes projecting inward, one in middle of lateral margin of each segment and one along each suture; no transverse blotches, or only faint indications of brownish color; last segment broad, rounded behind, with numerous long hairs.

Female. Body, length 2.3 mm., width .9 mm.; head, length .4 mm., width .72 mm.; last segment of abdomen more flatly rounded, with a tuft of hair at each posterior angle and a fringe of hairs of equal size along the posterior margin, giving the tip of abdomen a truncate appearance.

Menopon melanorum n. sp. (Plate lxxiii, fig. 1.)

Taken on a Towhee, *Pipilo erythrophthalmus* (Lawrence, Kansas).

Description of female. Body, length 1.37 mm., width .56 mm.; pale golden brown, with black occipital margin of head, blackish brown ocular blotches and mandibles, and brown transverse abdominal blotches distinct only laterally.

Head, length .31 mm., width .47 mm., rather long in comparison with its width for *Menopon;* front rounded, with usual few short hairs in front of barely projecting palpi, and two longish ones in front of ocular emarginations; the emargination distinct, shallow, and with ocular fringe; temples broad, rounded, with a few hairs of different lengths, including at least one very long hair; occipital margin concave, straight in middle, with two longish and two short hairs; occipital margin narrowly but conspicuously bordered with black; indications of widely separated, translucent, occipital bands, convex outwardly; ocular blotches small, narrow, linear, curving, blackish in middle, paling at each end; a small black ocular fleck; a brown spot on margin outside of each mandible, and connected with mandibles by indistinct brownish bands.

Prothorax with slightly produced blunt lateral angles bearing three spines; nearly straight posterior margin with four longish hairs; the chitin bars indistinct, no blotches. Metathorax with slight lateral emargination, and indications of suture between meso- and metathorax; metathorax with a spine and very long hair in posterior angles, and eight weak hairs along the posterior margin, four on each side of the bare middle part; anterior angles of mesothorax dark brown; otherwise both segments unicolorous, concolorous with pale ground color of body. Legs concolorous with thorax, with darker indistinct marginal and terminal margins.

Abdomen short, broad, ovate, not turbinated; a single very long hair and a spine in posterior angles of segments; broad, pale brown, transverse bands across all segments but the last, these bands, however, hardly apparent on the middle region of the body, but distinct laterally, the lines of demarcation between pale and darker parts of band rather sharply defined; last segment broad, flatly rounded, uncolored, with a fine fringe of short, uncolored hairs.

Menopon incertum n. sp. (Plate lxxiii, fig. 2.)

Specimens from an American Gold Finch, *Spinus tristis*, and from a Russet-backed Thrush, *Turdus ustulatus* (Palo Alto, California). This is one of these species which might be referred almost indifferently to *Menopon* or to *Colpocephalum*. Because Giebel has referred to a somewhat similar form, *thoracicum* (Insecta Epizoa p. 287) from *Turdus viscivorous*, to *Menopon*, I assign this species to the same genus. The new species differs from *thoracicum* in the hairs of the prothorax, in the straight, not angulated, posterior margin of the mesothorax, in lacking a complete series of hairs along the posterior margin of the metathorax, in the presence of the characteristic spines of the posterior angles of the abdominal segments, and in other particulars. The ocular emarginations of the head are distinct, " fast colpocephalisch," as Giebel says of *thoracicum*.

Description of the male. Body, length 1.16 mm., width .48 mm.; pale brown, with distinct, broad, dark brown, transverse, abdominal bands, and blackish lateral bands; head two-thirds as long as wide.

Head, length .28 mm., width .44 mm.; rather elongate for *Menopon*, with distinct ocular emarginations; rounded in front, with a few short hairs; two longer hairs (one longer than the other) in front of emargination; ocular fringe distinct; temporal margin with four long hairs, of which two are very long, and a few shorter hairs; occipital margin concave, straight in the middle; palpi projecting slightly; occipital margin narrowly bordered with black; temples clouded; a curving, blackish brown, ocular blotch, and in front of its anterior end a small, blackish brown, submarginal blotch.

Prothorax short, broad, the lateral angle being but little produced, with two short strong spines and no hair, and the posterior angles very obtuse, hardly apparent; the posterior margins flatly convex, with six short strong hairs; segment without distinct colored blotches or border; the transverse chitin bar slender, inconspicuous. Metathorax with fine but distinct suture, separating mesothorax; just behind the suture a transverse series of a few very small spines; posterior angles of metathorax with three spines and a hair, two of the spines projecting laterally, the other spine and hair projecting posteriorly; posterior margin straight, with a marginal series of hairs; the posterior angles of the segment are obtuse and project laterally conspicuously beyond the abdomen. Legs concolorous with body, with ill-defined marginal markings.

Abdomen short, elliptical, lateral margins projecting but little; posterior angles with two short, strong, distinct spines, and usually with a long hair; a broad transverse brown band entirely across each segment, paler in middle, darker at lateral extremities so as to form broad, dark, lateral bands; the sutures broad, uncolored; last segment with uncolored posterior border, flatly convex or almost straight, with a few short hairs, and at each side a long, strong, prominent hair.

Female. Body, length 1.34 mm., width .5 mm.; head, length .31 mm., width .44 mm.; thus being little larger than the male; the posterior margin of last abdominal segment is uncolored, more convex than in the male, and bears a fringe of short, fine, transparent hairs.

Menopon longicephalum n. sp. (Plate lxxiii, fig. 4.)

One male and one female taken from a domestic Pigeon, *Columba livia* (Lawrence, Kansas). Not at all like the uncommon but long known *Menopon* of the Pigeon, *giganteum*, Denny (Anoplur. Brit., p. 225, pl. xxi, fig. 2), or *latum*, Piaget (Les Pediculines, p. 457, pl. xxxvii, fig. 1), but an elongate slender form with head nearly two thirds as long as wide, much like *brevipes*, Piaget (Supplement, 1885, p. 110, pl. xii, fig. 1), from *Crossoptilon mantschuricum*, or *triseriatim*, Piaget (Les Pediculines, p. 460, pl. xxxvii, fig. 3), from *Gallus bankiva*.

Description of male. Body, length 1.5 mm., width .66 mm.; elongate, with narrow tapering head and narrow tapering posterior region of abdomen; whitish, with translucent lateral bands and with inconspicuous head markings.

Head, length .31 mm., width .47 mm.; thus being elongate and narrow for *Menopon;* front parabolic, with one short hair on each side in front of slightly projecting palpi, and one long hair and two short in front of the shallow ocular signature; emargination with ocular fringe running slightly on temporal margin; temples protruding but little laterally, and with one long hair and three short ones; occipital margin weakly concave, with a few hairs of different lengths; small, black, ocular fleck and pale, clear, brownish coloration at side of and behind mandibles.

Prothorax short, broad, with produced lateral angles with a spine in each angle, and a series of fourteen strong, sharply pointed hairs along the convex posterior margin; no blotches. Metathorax short, broad; lateral margin with two or three spines, angles with a hair and nearly straight posterior margin with a series of hairs weaker than those of the prothorax. Legs pale, concolorous with body, with short stiff hairs on femora and tibiæ.

Abdomen elliptical, narrow at both ends, with numerous strong hairs in posterior angles of segments and on lateral margins; numerous hairs on dorsal surface; whole abdomen whitish, with narrow, clear, lateral bands, with lateral processes projecting inward from anterior angles of each segment; last segment uncolored, parabolic, with four hairs on posterior margin, two near each end and none in the middle.

Female. Body, length 1.6 mm., width .69 mm.; head, length .31 mm., width .47 mm.; abdomen elongate-ovate, tapering at posterior end, the last segment uncolored, narrowly rounded behind, with a fringe of fine uncolored hairs along posterior margin.

Menopon dissimile n. sp. (Plate lxxiii, fig. 5.)

One male, one female, and one immature specimen, from the Purple Martin, *Progne subis* (Lawrence, Kansas), resembling somewhat *M. rusticum*, Giebel (Insecta Epizoa, p. 288), from *Hirundo rustica* and *H. riparia*, but more than a third larger, without the well marked antennæ and ocular bands of *rusticum*, and with spines and hairs on the prothorax, which is bare in *rusticum*. This species and *rusticum* present a *Menopon* type which in the shape and character of the head and thorax and in the sternal markings approaches *Nitzschia*.

Description of the male. Body, length 1.8 mm., width .62 mm.; pale, clear, yellowish brown, with small black ocular flecks, slightly darker thorax, indistinctly indicated lateral bands, parallel inner logitudinal bands, and numerous short, stiff, spiny hairs on dorsal surface of abdomen.

Head, length .35 mm., width .55 mm.; not so much wider than long as usual in *Menopon;* forehead or region in front of ocular emargination long; front flatly rounded, with a few short hairs and two longish ones, one longer than the other on a slight swelling in front of the ocular emargination; the ocular fringe distinct, composed of curving, stiff hairs; temples with anterior angles somewhat produced, and four long and two or three short hairs on the margin; small black ocular flecks; weakly colored, translucent, narrow, curving, ocular blotches, and a weakly colored region outside of each mandible; occipital margin medially, narrowly, weakly colored, translucent, with two short median hairs and a shorter one at each side of these two.

Prothorax hexagonal, almost as long as broad, the lateral anterior sides short, the lateral angles obtuse, but little produced, with two spines and a short, stiff hair; posterior margin slightly angulated in the middle, and with six longish hairs, the terminal one being in the posterior angles of the segment; whole segment slightly darker than the head, with short, transverse, uncolored, chitin bar. Metathorax with lateral emargination and faint sutural line between meso- and metasegments; lateral margins bare; posterior angles with two spines and the terminal one of a series of submarginal hairs which are ranged along the straight or very weakly convex posterior margin; anterior angles and lateral margin slightly darker, but otherwise the whole segment concolorous with prothorax.

Legs with weakly colored, translucent, dorsal margins on femora and tibiæ; anterior coxæ with bluntly conical processes. Sternal markings ill-defined but apparently composed of longitudinal and transversal narrow bands without median blotches.

Abdomen elongate-elliptical, slightly turbinated, with a strong hair in each posterior angle and a few short hairs along the lateral margins of the segments; dorsal surface with a regular row of short, sharp, spiny hairs on the posterior margin of each segment; on segment 1 no other dorsal hairs; on segment 2 an additional single irregular row across the segment, and on segments 3–8 two additional irregular rows; last segment without rows of short spiny hairs, rounded behind, with four long hairs in lateral groups of two each, and posterior margin with four short, fine hairs; segment 8 has two long conspicuous hairs rising one in the middle of each lateral half of the posterior margin; genitalia of the usual *Menopon* type, an unpaired, long, strong, longitudinal bar with two strong, diverging prongs at posterior angle; ventral surface of abdomen possesses, in addition to transverse rows, groups of short spiny hairs near each lateral margin; on the posterior margin of segment 2 there are a few, four to six, very strong spines in two lateral groups; color of abdomen same as that of head and legs, with narrow, translucent, lateral bands, having two short, rounded, inward-projecting processes in each segment; in addition there is a second inner, narrow, regular, lateral band parallel with the outer margin.

Female. Body, length 2.16 mm., width .81 mm.; head, length .34 mm., width .56 mm.; darker, without second inner lateral band, and with the inward-projecting process of the outer or true lateral band shorter, but the band distinctly darker colored than rest of body, although subtranslucent; metathorax also with distinct dark subtranslucent lateral bands; dorsal surface of abdomen without short spiny hairs, and with a few longer weak hairs arranged in complete transverse rows on segments 1–3, but decreasing in number on posterior segments; last segment with posterior margin rounded about as in male, but with fringe of closely set, short, weak, finely pointed hairs; ventral surface of abdomen with the lateral groups of short spiny hairs as in male.

Menopon mesoleucum Nitzch. (Plate lxxiii, fig. 3.)

Germar's Mag. Entomol., 1818, vol. iii, p. 300.

Ricinus cornicis **De Geer, Mem. Ins., 1778, vol. vii, pl. 4, fig. 11.**

Menopon mesoleucum **N., Burmeister, Handb. f. Ent., 1835, vol. ii, p. 439; Giebel, Zeitschr. f. ges. Naturwiss, 1866, vol. xxvii, p. 119; ibid, Insecta Epizoa, 1874, p. 281, pl. xiv, figs. 11, 12; Piaget, Les Pediculines, 1880, p. 426, pl. xxxiv, p. 7.**

A large variety of this species from the American Crow, *Corvus americanus* (specimens from Lawrence, Kansas, and Palo Alto, California). Nitzsch's type-specimens were taken from *Corvus cornix* and *C. corone*. The American specimens are uniformly larger than the type-form (length of *mesoleucum*, male 1.4 mm., female 1.8 mm.; length of var. *americanum*, male 1.7 mm., female 2.12 mm.), and vary from the descriptions of Giebel and Piaget in various particulars.

Var. *americanum* Kellogg. Males, females and young from the American Crow, *Corvus americanus* (Lawrence, Kansas, and Palo Alto, California). Male. Body, length 1.7 mm., width .7 mm.; head, length .34 mm., width .6 mm. Female. Body, length 2.12 mm., width .75 mm.; head, length .37 mm., width .69 mm.

The species may be readily recognized by the marked difference in the sexes, the female having the metathorax produced backward and angulated on the abdomen (straight in the male), and with the transverse abdominal blotches of the first three or four segments broken in the middle and the lateral parts projecting diagonally inward and backward; in the male the blotches run evenly across the segments. I figure the male.

Nitzschia dubius n. sp. (Plate lxxiii, fig. 6.)

A few specimens from the Chimney Swift, *Chætura pelasgica* (Lawrence, Kansas). Much like *Nitzschia pulicaris*, Nitzsch, from the European Swift, *Cypselus apus*, but differs in lacking the pustulated hairs of temples and abdomen, and in the shape of the metathorax. The specimens are in poor condition and permit of only an unsatisfactory description.

Body, length 2.22 mm., width .88 mm.; elongate, with narrow neck-like prothorax; expanded posterior portion of abdomen with numerous very long hairs; head, thorax and legs pale, abdomen much darker.

Head, length .41 mm., width .72 mm.; shape of head of *pulicaris*, that is, triangular, with rounded front, a shallow concavity of the margin where the palpi project, a shallow ocular emargination, with conspicuous ocular fringe and expanded temples, the margins angulated in front and behind; the margin of forehead with six hairs on each side, the third and sixth being long; the temporal margins with four long hairs weakly pustulated, and a few very short hairs or spines; occipital margin concave, straight in middle, with four longish hairs; ground color pale tawny, with very small, black, ocular flecks, weakly colored, small, brownish, ocular blotches, strongly colored mandibles, and a weakly colored region outside of each mandible.

Prothorax subquadrangular, with shortly produced rectangular angles in lateral margins before the middle, each angle with two spines and a hair; posterior angles rounded and the nearly straight, slightly sinuous, posterior margin with six weak hairs; a weakly indicated, uncolored, transverse, chitin bar about even with lateral angles; no distinct blotches. Meso- and metathorax fused, although the line of fusion is marked by a lateral emargination and by an indicated transverse suture; posterior angles of metathorax with two spines and a hair; the straight posterior margin with a submarginal series of short and longer hairs interrupted at the middle; on the dorsal surface of the metasegment six short spines arranged in two diagonal series of three each. Legs long, slender, concolorous with thorax, with fringes of short hairs along dorsal margins of femora and tibiæ. Sternal markings weakly indicated but of the type described as characteristic of *Nitzschia*, consisting essentially of an open quadrilateral without median blotches.

Abdomen widening posteriorly to segment 6; segment 7 a little narrower than segment 6, and segments 8 and 9 narrowing more rapidly; all segments with two to three spines in posterior angles and long hairs, increasing in length and number on posterior segments, those on segments 6–9 being especially long, numerous, and hence conspicuous; segment 9 short, flatly convex behind, with two very long hairs at each end of posterior margin and a sparse fringe of five uncolored hairs along the margin; narrow, translucent, brownish, lateral bands, and the whole abdomen dark, because crossed by broad transverse bands, almost completely covering the surface: posterior margin of each segment with a series of weak hairs.

DISTRIBUTION.

Concerning the distribution of the Mallophaga, I have little to add to the remarks made in my previous paper. Among the land birds of America there are very few which are identical with the Old World species. On those are found parasites identical, or nearly so, with the Old World Mallophaga of the same hosts. On the domestic pigeon, *Columba livia*, I find *Lipeurus baculus* and *Goniocotes compar*, both common on the European individuals of the same host species. In addition, I find a *Menopon* on the pigeon not met with by the European authors. On the Snow Owl, *Nyctea nyctea*, I find *Docophoros ceblebrachys*, described by Nitzsch from the same host. And there are a few other similar examples.

As among the water birds, where I have found previously described Mallophaga on American birds not identical with Old World species, these parasites have been found, almost always, on American birds very closely related to the European hosts. For example, the characteristic *Docophorus rostratus* Nitzsch, of the European Barn Owl, *Strix flammea*, I have found on the American Barn Owl, *Strix pratincola*. It is of interest to note that the American owl has been until recently ranked as a variety simply of the European species. The striking *Menopon mesoleucum* of the various Old World crows (*Corvus corone*, *frugilegus*, *et al.*), is found on the American Crow, *Corvus americanus*, though showing such constant differences as to compel me to give it a varietal name. There are several other examples of this condition presented in this paper.

Apparent exceptions to the general statement that American Mallophaga identical with Old World species are found on American hosts identical with or very nearly related to Old World hosts, are presented by *Docophorus communis* and *Nirmus fuscus*. These two parasite species are found, common, in one case, to many passerine birds, and in the other, to several raptorial birds, which differ generically from the Old World hosts. It will be noted, however, that both of these species have a wide range of hosts in both Europe and America. The fact is that we have to do here, in each case, with a group of closely allied, insensibly gradating forms, rather than with a single well marked Mallophagous species. That this condition has been recognized by the European authors is shown in the cases of both *Docophorus communis* and *Nirmus fuscus*, by the attempts which have been made by Giebel and Piaget to break up these species into several distinct species (Giebel), or into subspecies (Piaget).

Finally with regard to the constant or occasional appearance of the parasites on the hosts, I can add also but little. In the preparation of this paper I have had no such long series of specimens of one bird species as it was my privilege to have of certain species of maritime birds. As an illustration of the varying degrees of prevalence of different parasite species infesting a single bird species, the parasites of *Carpodacus mexicanus frontalis*, the House Finch, may be referred to. Of nine specimens of this bird species examined, six were infested by *Docophorus communis*, four by *Nirmus vulgatus*, and one by *Physostomum microcephalum*. Of three specimens examined of the closely related *Carpodacus purpureus californicus*, the California Purple Finch, *Docophorus communis* was found on each, but no *Nirmus* nor *Physostomum* on any. *Physostomum* as a parasite, however, is not always uncommon on its host, as the case of *Physostomum diffusum*, found on five out out of seven specimens of *Melospiza fasciata samuelis*, attests.

Comparing the land birds with the water birds as hosts for Mallophaga, I find that many more individuals among land birds than among water birds are free from parasites, and that among the infested birds the number of individuals of Mallophaga on a single bird individual is much greater among the water bird species than among the land bird species. It is noticeable that the larger land birds such as hawks and grouse show many more parasites than the smaller birds; and to some extent the greater abundance of parasites on water birds may be due to their distinctly larger average size as compared with land birds.

LIST OF HOSTS AND PARASITES.

- Colinus virginanus.
  - Lipeurus dissimilis.
- Callipepla californica.
  - Lipeurus docophoroides.
  - Goniodes mammillatus.
- Phasianus nycthemerus.
  - Lipeurus introductus.
  - Goniodes cervinicornis.
  - Goniocotes creber.
  - Menopon monostœchum.
- Columba livia.
  - Lipeurus baculus.
  - Goniocotes compar.
  - Menopon longicephalum.
- Elanus leucurus.
  - Colpocephalum osborni.
  - Menopon decoratum.
- Circus hudsonius.
  - Nirmus fuscus.
- Buteo swainsoni.
  - Nirmus fuscus.
- Archibuteo lagopus sancti-johannis.
  - Docophorus taurocephalus.
  - Nirmus fuscus.
  - Colpocephalum flavescens.
- Haliæetus leucocephalus.
  - Nirmus discocephalus var. amblys.
  - Colpocephalum flavescens.
- Bubo virginianus.
  - Docophorus cursor.
- Nyctea nyctea.
  - Docophorus ceblebrachys.
- Strix pratincola.
  - Docophorus rostratus.
- Dryobates pubescens.
  - Docophorus evagans.
- Melanerpes formicivorus bairdi.
  - Docophorus californiensis.
- Colaptes auratus.
  - Docophorus alienus.
    - jungens.
- Chordeiles virginianus henryi.
  - Lipeurus macrocephalus.
- Chætura pelagica.
  - Nitzschia dubius.
- Trochilus anna.
  - Nirmus eustigmus.
- Trochilus rufus.
  - Nirmus snodgrassi.

Tyrannus tyrannus.
    Physostomum angulatum.
Empidonax difficilis.
    Physostomum sucinaceum.
Otocoris alpestris.
    Docophorus communis.
Corvus corax sinuatus.
    Docophorus distinctus.
Corvus americanus.
    Docophorus atratus.
    Menopon mesoleucum var. americanum.
    Colpocephalum subæquale.
Molothrus ater.
    Docophorus transpositus.
Agelaius phœniceus.
    Docophorus communis.
    Nirmus illustris.
Sturnella magna neglecta.
    Docophorus communis.
Icterus bullocki.
    Docophorus communis.
Carpodacus purpureus californicus.
    Docophorus communis.
    Nirmus vulgatus.
Carpodacus mexicanus frontalis.
    Docophorus communis.
    Nirmus vulgatus.
    Physostomum microcephalum.
Spinus tristis.
    Menopon incertum.
Spinus psaltria.
    Docophorus communis.
Spinus pinus.
    Docophorus communis.
Calcarius lapponicus.
    Docophorus communis.
Ammodramus sandwichensis.
    Docophorus communis.
    Physostomum diffusum.
Zonotrichia coronata.
    Nirmus vulgatus.
    Physostomum diffusum.
Zonotrichia gambeli.
    Nirmus vulgatus.
Junco hyemalis.
    Docophorus communis.
    Nirmus vulgatus.
    Physostomum diffusum var. pallidum.
Melospiza fasciata samuelis.
    Physostomum diffusum.
    Colpocephalum chrysophæum.
Passerella iliaca.
    Physostomum angulatum.
Pipilo erythrophthalmus.
    Menopon melanorum.
Pipilo fuscus crissalis.
    Nirmus vulgatus.
Pipilo maculatus megalonyx.
    Nirmus vulgatus.
Cardinalis cardinalis.
    Docophorus communis.
Passerina versicolor.
    Physostomum australe.
Progne subis.
    Docophorus domesticus.
    Menopon dissimile.
Petrochilidon lunifrons.
    Docophorus excisus var. major.
    Nirmus longus.
Tachycineta bicolor.
    Docophorus excisus var. major.
    Nirmus longus.
Ampelis garrulus.
    Docophorus communis.
Ampelis cedrorum.
    Docophorus incisus.
Lanius ludovicianus excubitorides.
    Docophorus communis.
Harporhynchus rufus.
    Docophorus communis.
Psaltriparus minimus.
    Colpocephalum fumidum.
    Menopon robustum.

Turdus ustulatus.
Menopon incertum.
Merula migratoria.
Docophorus communis.
Nirmus vulgatus.
simplex.
Sialia sialis.
Docophorus incisus.

EXPLANATION OF PLATES.

PLATE LX.—Fig. 1, Head of *Colpocephalum flavescens*, under side; *a* labrum, *b* labial palpi, *c* maxillary palpi, *d* antennæ (after Nitzsch). Fig. 2, Maxilla of *Trinotum conspurcatum* (after Nitzsch). Fig. 3, Labium of *Trinotum conspurcatum* (after Nitzsch). Fig. 4, Labium of *Tetropthalmus chilensis* [*Menopon titan*]; *m* mentum, *p l* labial palpus, *g* glossa, *pg* paraglossa, *hy* hypopharynx (after Grosse). Fig. 5, Labium of a *Nirmus; g* glossa, *pg* paraglossa (after Grosse). Fig. 6, Head, ventral aspect, with median part of labium cut away, of *Ancistrona gigas; lb* labrum, *md* mandible, *lp* labial palpus, *hy* hypopharynx, *f k* labial fork, *a f* antennary fossa. Fig. 7, Labium, ventral aspect, of *Ancistrona gigas; s m* submentum, *m* mentum, *p r* labial prong, *p* palpifer, *lp* labial palpus, *lig* ligula, *g* glossa, *pg* paraglossa. Fig. 8, Maxilla of *Ancistrona gigas*. Fig. 9, Right mandible, ventral aspect, of *Ancistrona gigas; ten* tendon, *mus* muscle, *v ch r* ventral chitinous rod, *d ch r* dorsal chitinous rod. Fig. 10, Mandibles, ventral aspect, of *Ancistrona gigas; c* condyles, *r* right mandible, *l* left mandible. Fig. 11, Hypopharynx of *Ancistrona gigas*. Fig. 12, Left labial fork, ventral aspect, of *Ancistrona gigas; mus* muscle.

PLATE LXI.—Fig. 1, Head, ventral aspect, of *Læmobothrium* sp.; *sm* submentum, *m* mentum, *ant* antenna, *clyp* clypeus, *lb* labrum, *md* mandible, *mx* maxilla, *g* glossa, *pg* paraglossa, *lp* labial palpus. Fig. 2, Mandibles, ventral aspect, of *Læmobothrium* sp.; *c* condyles, *r* right mandible, *l* left mandible. Fig. 3, Right maxilla, ventral aspect, of *Læmobothrium* sp. Fig. 4, Labium, ventral aspect, of *Læmobothrium* sp.; *sm* submentum, *m* mentum, *g* glossa, *pg* paraglossa, *pf* palpifer, *lp* labial palpus. Fig. 5, Labial glands of *Læmobothrium* sp. Fig. 6, Left maxilla, ventral aspect, of *Goniodes cervinicornis*. Fig. 7, Labium, ventral aspect, of *Goniodes cervinicornis; g* glossa, *pg* paraglossa. Fig. 8, Mandibles, posterior aspect, of *Goniodes cervinicornis*. Fig. 9, Right mandible, posterior aspect, of *Goniodes cervinicornis; c* condyle, *ch pls* chitinous plates.

PLATE LXII.—Fig. 1, Head, ventral aspect, with labium represented as transparent, of *Eurymetopus taurus; ant* antenna, *tr* trabecula, *md* mandible, *clyp* clypeus, *g* glossa, *pg* paraglossa, *œ s* œsophageal sclerite, *l g* "lingual gland." Fig. 2, Œsophageal sclerite, dorsal aspect, of *Eurymetopus taurus; d* duct, *d o* opening of duct, *m g* middle groove, *ant h* anterior horn, *b s* "bonnet string." Fig. 3, Œsophageal sclerite, lateral aspect, of *Eurymetopus taurus; ant h* anterior horn, *bs* "bonnet string." Fig. 4, Right maxilla, ventral aspect, of *Eurymetopus taurus.* Fig. 5, Mandibles, ventral aspect of *Eurymetopus taurus; c* condyles, *r* right mandible, *l* left mandible. Fig. 6, Labium, ventral aspect, of *Eurymetopus taurus; sm* submentum, *m* mentum, *g* glossa, *pg* paraglossa. Fig. 7, "Lingual gland," ventral aspect, of *Eurymetopus taurus; d* duct, *œs* œsophageal sclerite, *ch ped* chitinous pedicle. Fig. 8, Left "lingual gland," ventral aspect, of *Eurymetopus taurus; d* duct, *ch ped* chitinous pedicle, *mus* muscle, *l g* the gland.

PLATE LXIII.—Fig. 1, Labium of *Colpocephalum* sp.; *sm* submentum, *m* mentum, *pf* palpifer, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 2, Labium of *Trinoton luridum; sm* submentum, *m* mentum, *pf* palpifer, *l p* labial palpus, *g* glossa, *pg* paraglossa. Fig. 3, Labium of *Nirmus* sp.; *sm* submentum, *m* mentum, *g* glossa, *pg* paraglossa. Fig. 4, Mandibles, ventral aspect, of *Menopon titan; c* condyles, *r* right mandible, *l* left mandible. Fig. 5, Labium of *Physostomum angulatum; sm* submentum, *m* mentum, *pf* palpifer, *l p* labial palpus, *g* glossa, *pg* paraglossa. Fig. 6, Labium of *Nitzschia dubius*; *sm* submentum, *m* mentum, *pf* palpifer, *l p* labial palpus, *g* glossa, *pg* paraglossa.

PLATE LXIV.—Fig. 1, Labium of *Termopsis angusticollis; sm* submentum, *m* mentum, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 2, Maxilla of *Termopsis angusticollis; cd* cardo, *st* stipes, *pf* palpifer, *lac* lacinia, *gal* galea, *mx p* maxillary palpus. Fig 3, Labium of nymph of *Perla; sm* submentum, *m* mentum, *l p* labial palpus, *g* glossa, *pg* paraglossa. Fig. 4, Maxilla of nymph of *Perla; cd* cardo, *st* stipes, *lac* lacinia, *gal* galea, *mx p* maxillary palpus. Fig. 5, Head, ventral aspect, of *Atropos* sp.; *sm* submentum, *m* mentum, *mx* maxilla, *mx p* maxillary palpus, *md* mandible, *clyp* clypeus, *lb* labrum, *g* glossa, *pg* paraglossa, *fk* fork. Fig. 6, Mandibles of *Atropos* sp.; *c* condyles, *r* right mandible, *l* left mandible. Fig. 7, Head, dorsal aspect, of *Atropos* sp.; *clyp* clypeus, *ant* antenna, *œs* œsophageal sclerite. Fig. 8, Mandible and mandibular muscles of *Psocus* sp.; *fm* flexor muscle, *em* extensor muscle, *m* molar face of mandible (after Burgess). Fig. 9, Longitudinal section through middle of head of *Psocus* sp.; "*cl* clypeus, *l* labrum, *mand* mandible, the dotted line ending on the ribbed molar surface which tapers beneath into the sharp cutting edge; *mx* maxilla, *t* tongue, *f* fork, *lb* labium and *l p* its palpus, *m* mentum, *l g* lingual gland and *g m* its suspensory muscle, *œ* œsophagus opening below into the oral cavity at the base of which is the œsophageal bone, *œ b*; *f m* flexor muscle of the mandible and *l m* the muscle of the labrum, *c m* muscles of the clypeus, *g l* supra-œsophageal ganglion" (after Burgess). Fig. 10, Labium, posterior aspect, of *Psocus* sp.; "*m* mentum, *lb* labium, *l p* one-jointed labial palpus, behind which one sees the tip of the fork, *f*; *c* cardo, *p* stipes having the four-jointed maxillary palpus, *m x* lobe; through the mentum can be seen the lingual glands, *l g*, with their duct, *l d*" (after Burgess). Fig. 11, Œsophageal sclerite ("subœsophageal bone"), frontal aspect, of *Psocus* sp.; *l d* duct of the lingual gland (after Burgess).

PLATE LXV.—Fig. 1, *Docophorus taurocephalus* Kellogg, ♂. Fig. 2, *D. alienus* Kellogg, ♂. Fig. 3, *D. incisus* Kellogg, ♂. Fig. 4, *D. domestitus* Kellogg, ♂. Fig. 5, *D. distinctus* Kellogg, ♂. Fig. 6, *D. transpositus* Kellogg, ♀.

PLATE LXVI.—Fig. 1, *Docophorus cursor* N., ♀. Fig. 2, *D. evagans* Kellogg, ♀. Fig. 3, *D. ceblebrachys* N., ♂. Fig. 4, *D. jungens* Kellogg, ♀. Fig. 5, *D. rostratus* N., ♀. Fig. 6. *D. californiensis* Kellogg, ♂. Fig. 7, *D. communis* N., ♀.

PLATE LXVII.—Fig. 1, *Nirmus longus* Kellogg, ♀. Fig. 2, *N. simplex* Kellogg, ♀. Fig. 3, *N. eustigmus* Kellogg, ♀. Fig. 4, *N. illustris* Kellogg, ♂. Fig. 5, *N. vulgatus* Kellogg, ♀. Fig. 6, *N. discocephalus* var. *amblys* Kellogg, ♀. Fig. 7, *N. fuscus* N., ♀.

PLATE LXVIII.—Fig. 1, *Lipeurus introductus* Kellogg, ♀. Fig. 2, *L. snodgrassi* Kellogg, ♀. Fig. 3, *L. macrocephalus* Kellogg, ♀. Fig. 4, *L. baculus* N., head of ♂. Fig. 5, *L. introductus* Kellogg, head of ♂. Fig. 6, *L. baculus* N., ♀. Fig. 7, *L. dissimilis* P., head of ♀. Fig. 8, *L. docophoroides* P., ♀.

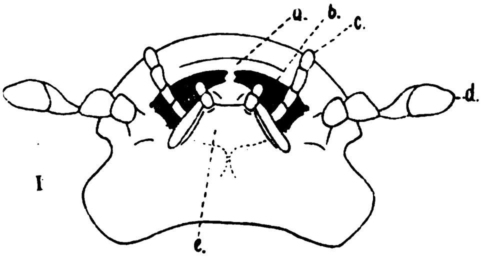
PLATE LXIX.—Fig. 1, *Goniodes cervinicornis* G., ♀. Fig. 2, *Goniodes mammillatus* Rudow, ♀. Fig. 3, *Goniocotes creber* Kellogg, ♀. Fig. 4, *Goniocotes compar* N., ♂.

PLATE LXX.—Fig. 1, *Physostomum microcephalum* Kellogg, ♀. Fig. 2, *P. sucinaceum* Kellogg, ♀. Fig. 3, *P. diffusum* Kellogg, ♀. Fig. 4, *P. australe* Kellogg, ♀. Fig. 5, *P. angulatum* Kellogg, ♀.

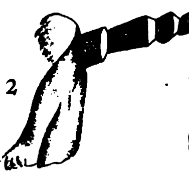
PLATE LXXI.—Fig. 1, *Colpocephalum chrysophæum* Kellogg, ♀. Fig. 2, *C. osborni* Kellogg, ♂. Fig. 3, *C. osborni* Kellogg, abdomen of ♀. Fig. 4, *C. flavescens* N., ♂. Fig. 5, *C. fumidum* Kellogg, ♀.

PLATE LXXII.—Fig. 1, *Colpocephalum subæquale* N., ♀. Fig. 2, *Menopon decoratum* Kellogg, ♂. Fig. 3, *M. robustum* Kellogg, ♀. Fig. 4, *M. monostæchum* Kellogg, ♂.

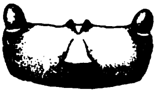
PLATE LXXIII.—Fig. 1, *Menopon melanorum* Kellogg, ♀. Fig. 2, *M. incertum* Kellogg, ♀. Fig. 3, *M. mesoleucum* N., ♂. Fig. 4, *M. longicephalum* Kellogg, ♀. Fig. 5, *M. dissimile* Kellogg, ♀. Fig. 6, *Nitzschia dubius* Kellogg, ♂ or ♀?



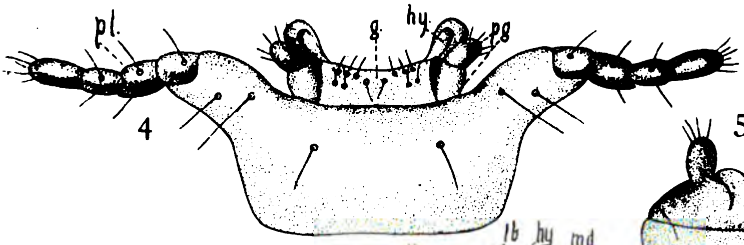
1



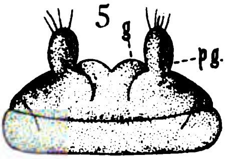
2



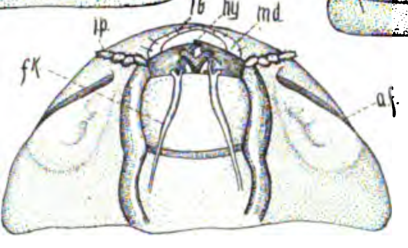
3



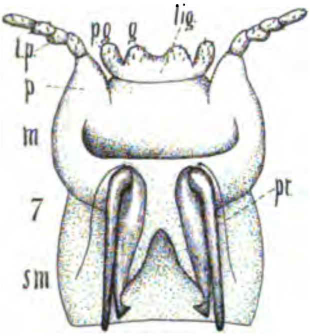
4



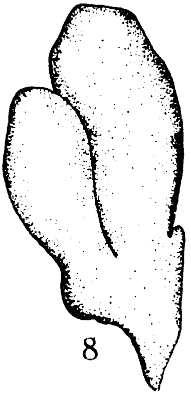
5



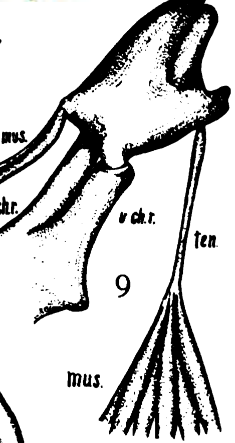
6



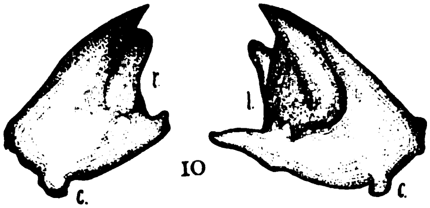
7



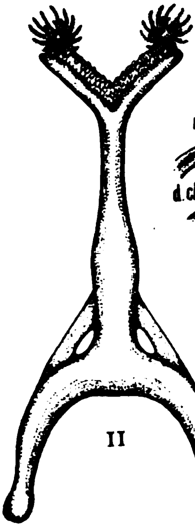
8



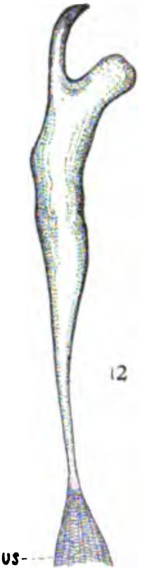
9



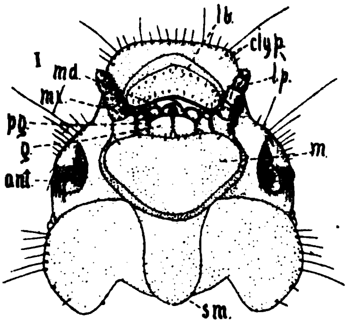
10

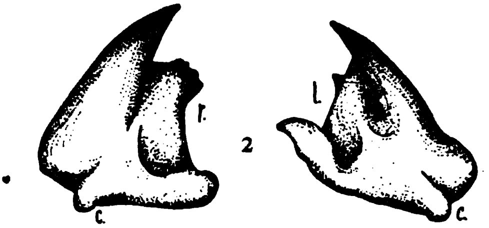


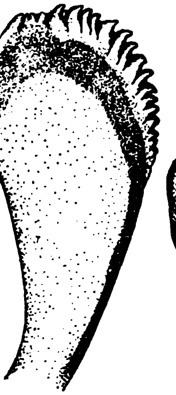
II

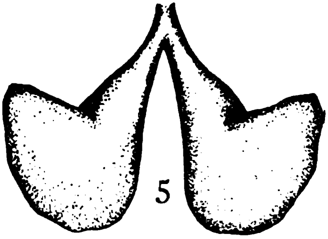


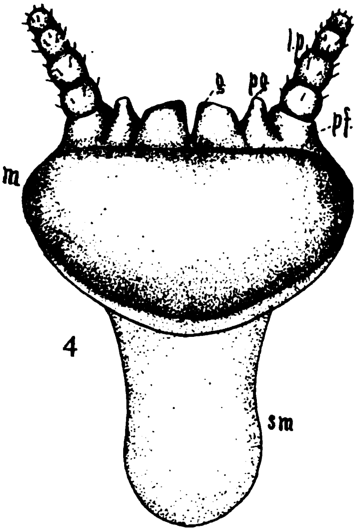
12

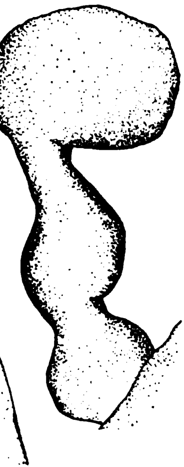


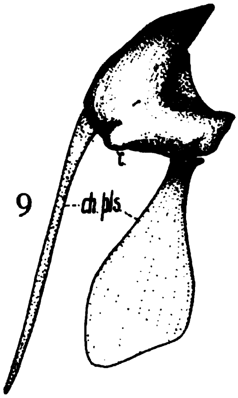

2

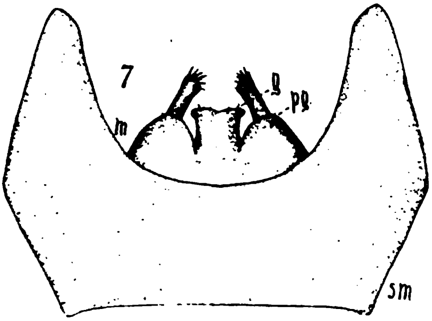

3

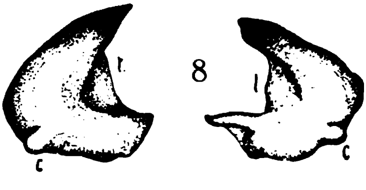

5


4


6

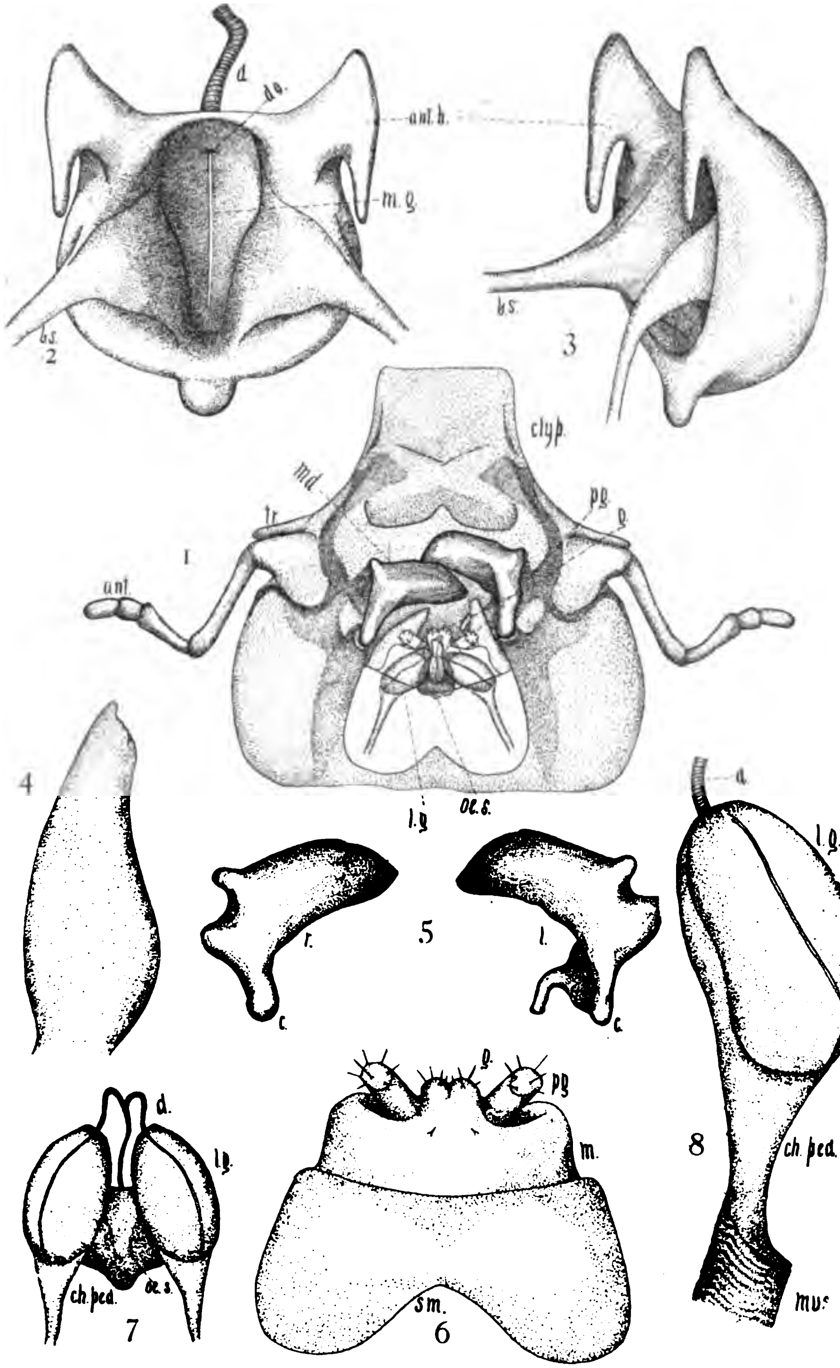

9

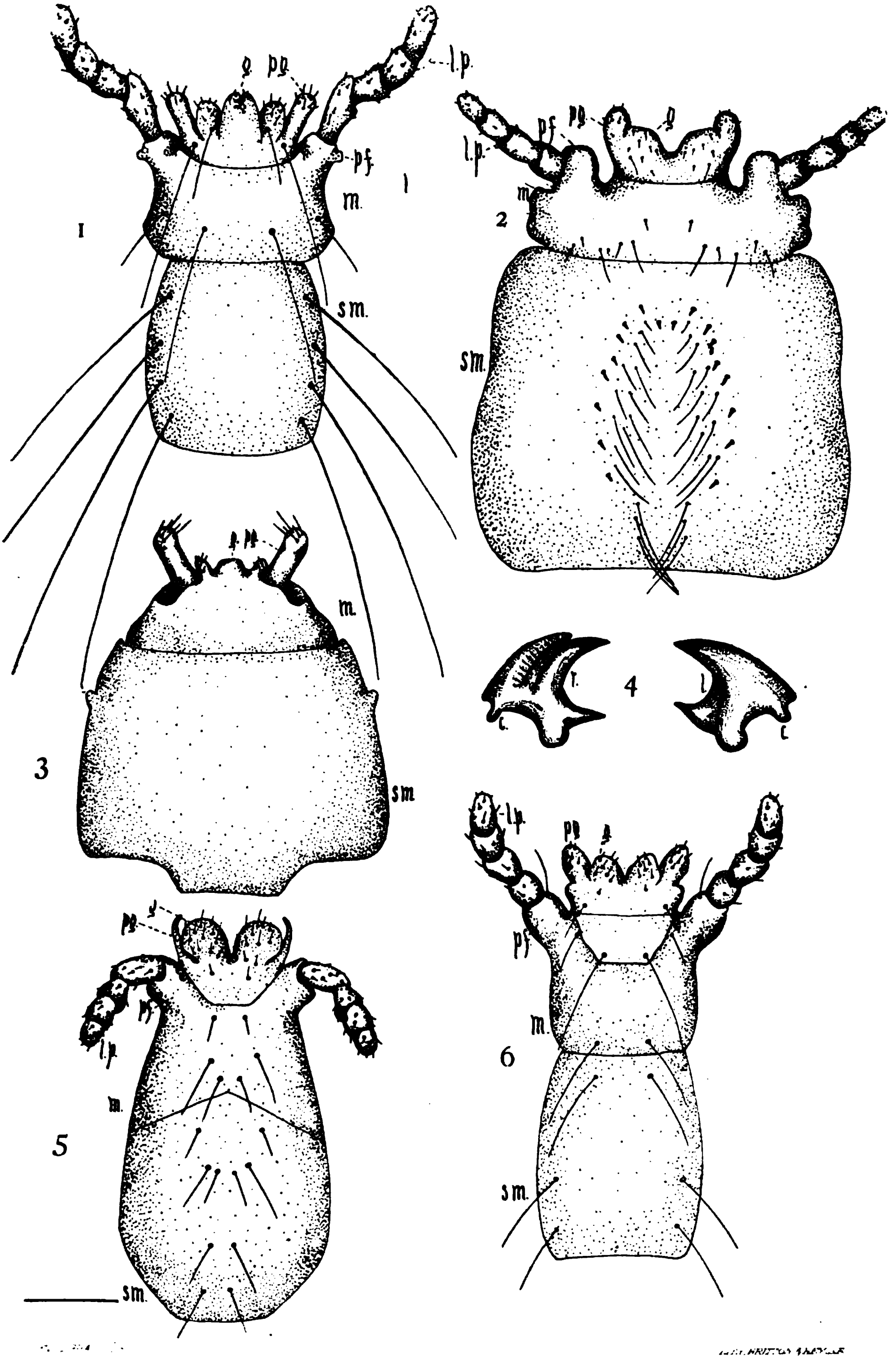

7

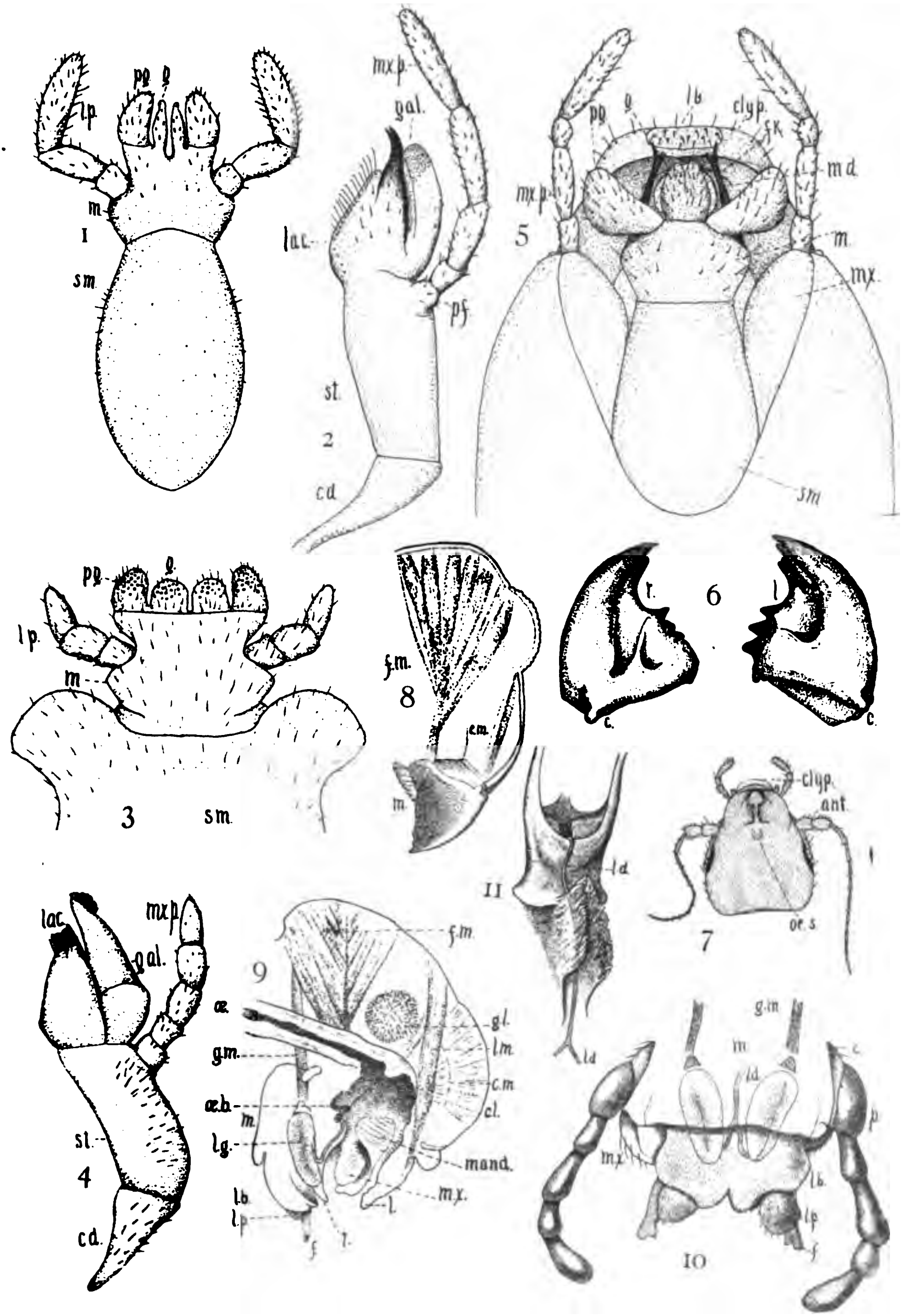

8

[illegible] del.   Lith. Britton & Rey S.F.

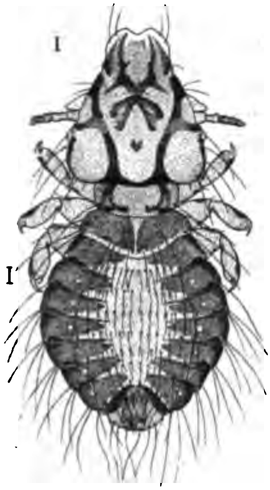
PLATE LXII.


d
oe.
ant. h.
m. g.
bs.
2
bs
3
clyp.
md
tr
pg
g
1
ant.
4
l. g
oe. s.
a.
l. g.
5
r.
l.
c.
c.
d.
lg.
ch. ped.
oe. s.
7
g.
pg
m.
sm.
6
8
ch. ped.
mus

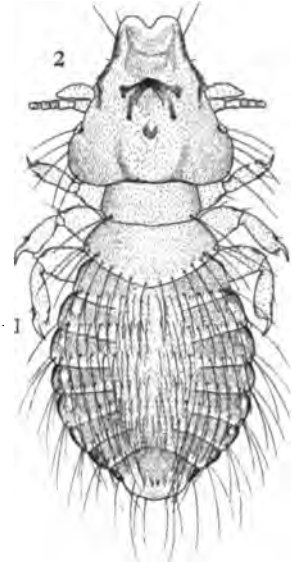

g
pg
l.p.
pf
m
sm
1
I
l.p.
pf
pg
g
m
2
sm
g pg
m
3
sm
r
4
l
c
c
l.p.
pg
g
pf
m
6
sm
g
pg
pf
l.p.
m
5
sm


1
pg
g
lp
m
sm
2
mx.p.
gal.
lac.
pf.
st.
cd.
5
pg
g
lb
clyp.
sk.
md
mx.p.
m
mx.
sm
3
pg.
g.
lp.
m
sm.
8
f.m.
em.
m.
6
r.
l
c.
c.
7
clyp.
ant.
oe.s.
11
ld
ld
4
lac.
mxp
gal.
st.
cd.
9
f.m.
œ
gl.
lm.
gm.
c.m.
œ.b.
cl.
m
lg.
mand.
lb
lp
mx.
l.
f
l.
10
g.m.
m
ld
c
p
mx
lb.
lp
f

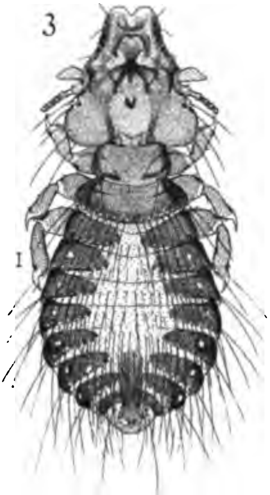
1



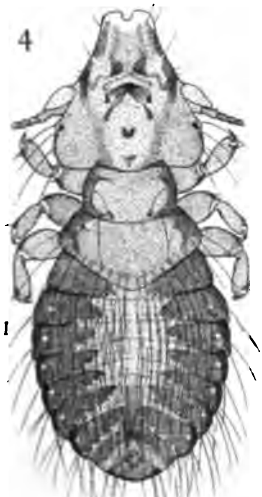
2



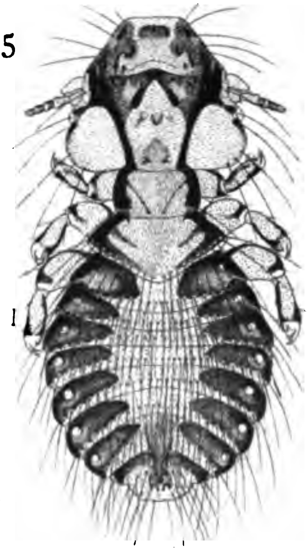
3



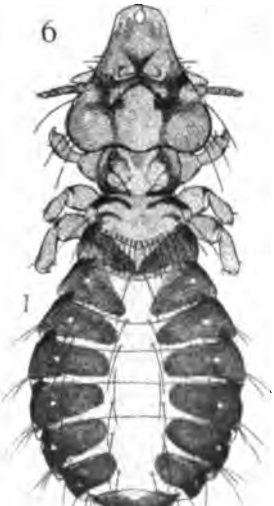
4



5



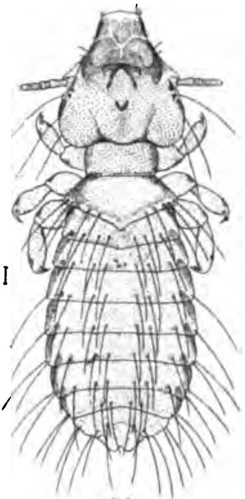
6



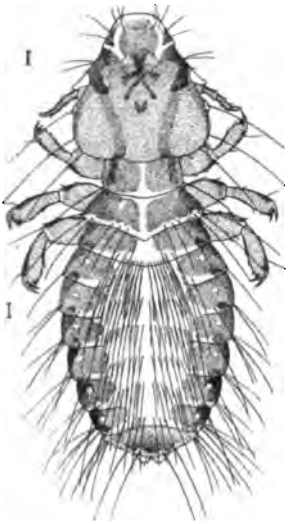
[illegible] del.

LITH. BRITTON & REY. S.F.

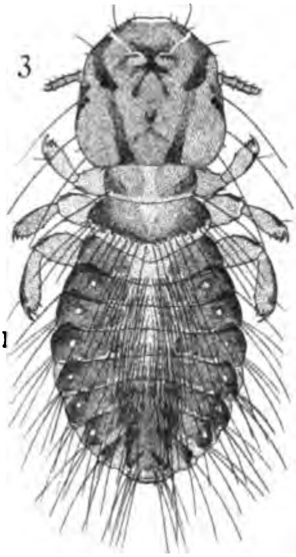
2



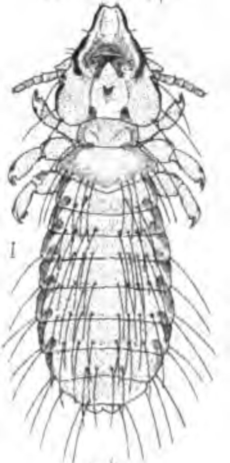
1



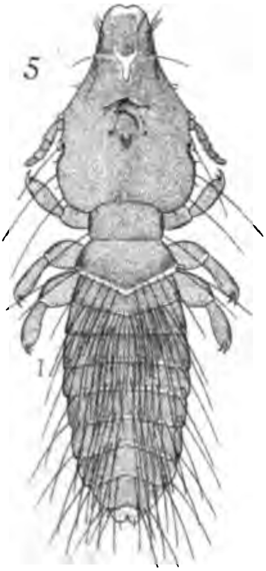
3



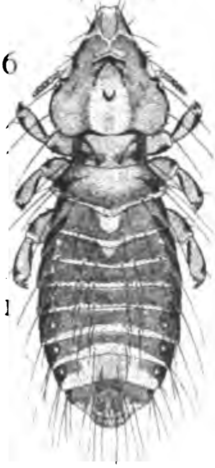
4



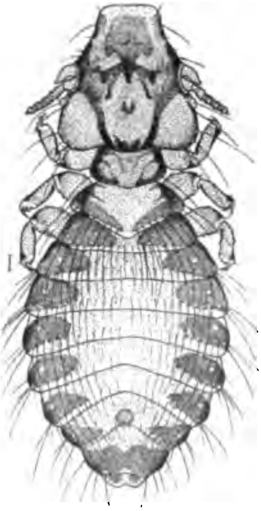
5



6



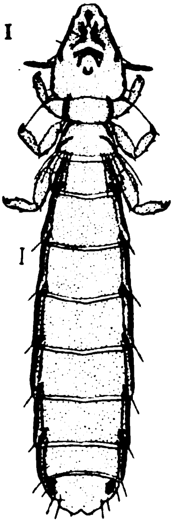
7



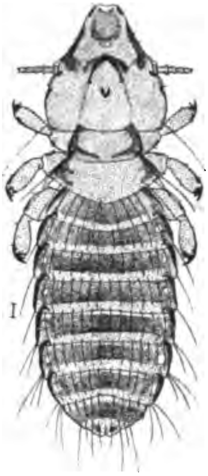
E. J. Jax. Del.

Lith. Britton & Rey S.F.

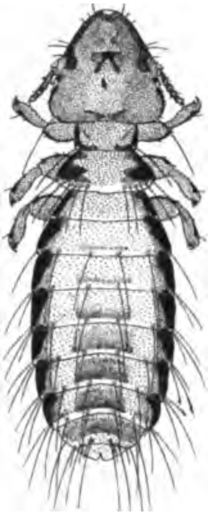
1



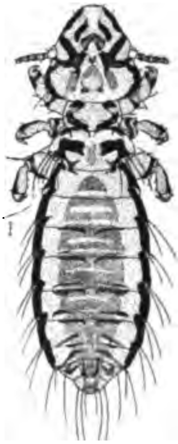
2



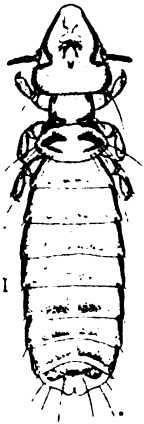
3



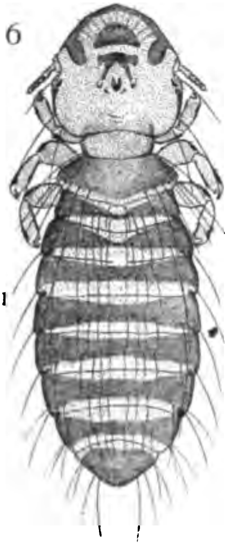
4



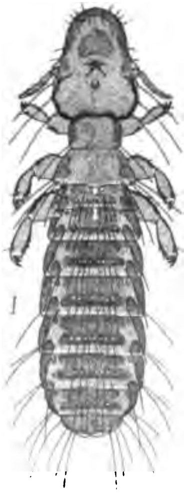
5



6



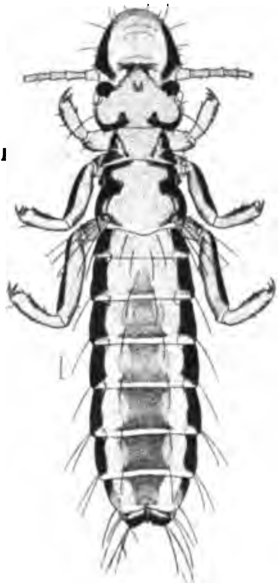
7



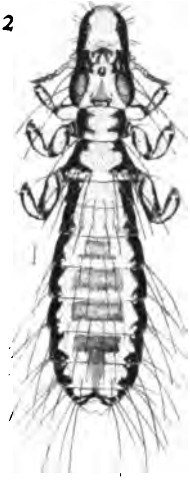
F. J. Jack Del.

Lith Britton & Rey S.F.

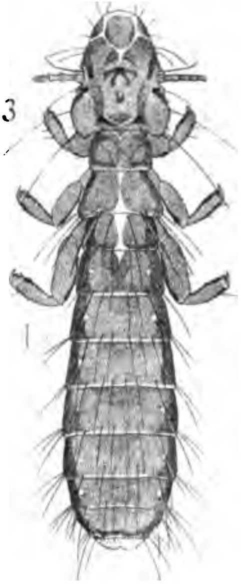
1



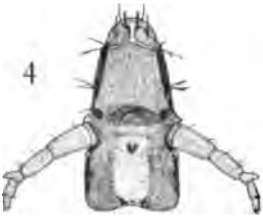
2



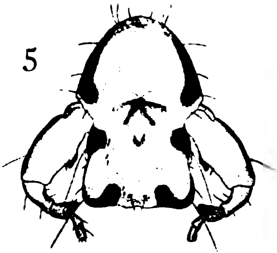
3



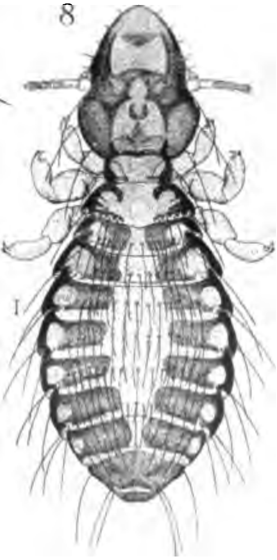
4



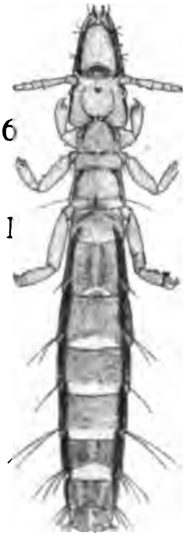
5



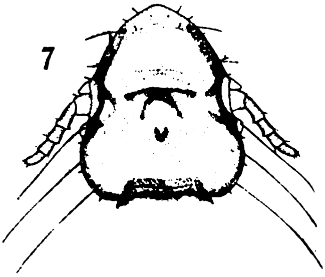
8



6

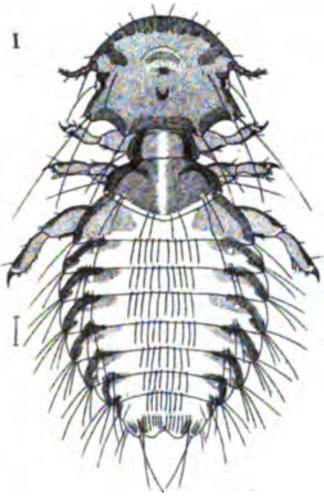


7

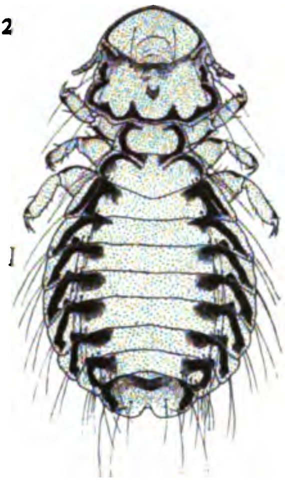


[illegible] [illegible]

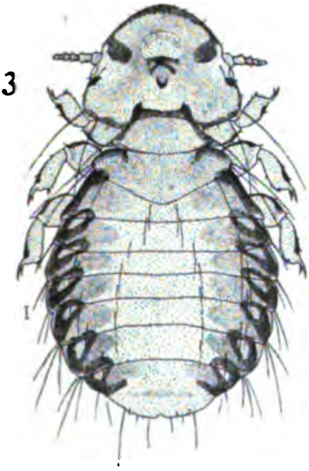
1



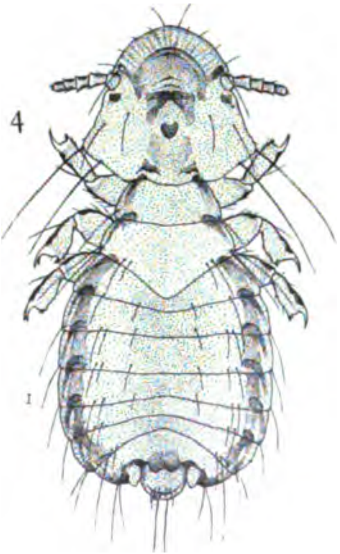
2



3



4

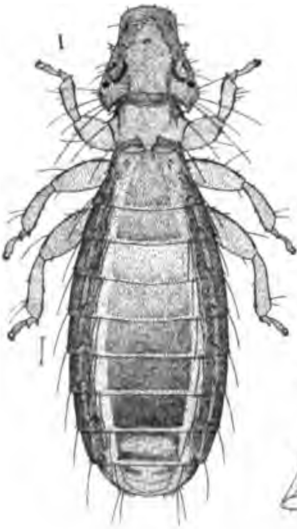


[illegible]

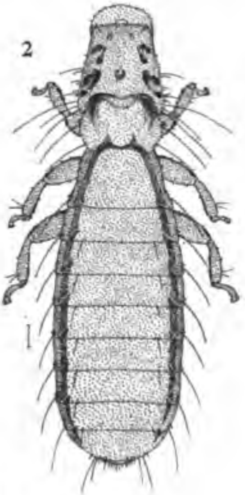
LITH. BRITTON & REY S.F.

PLATE LXX.

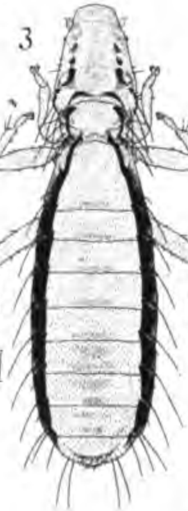
1



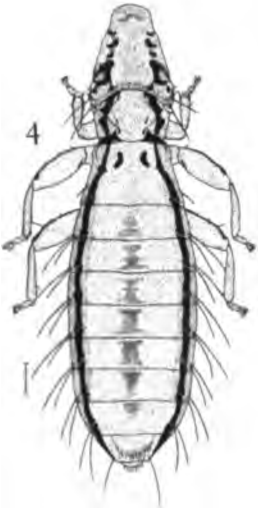
2



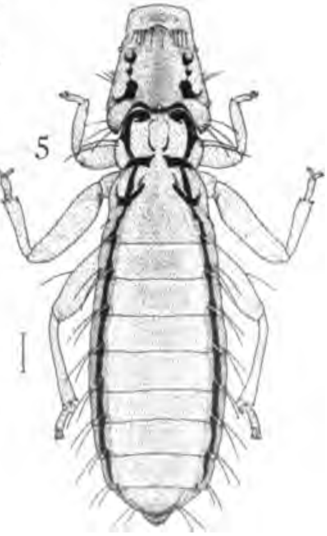
3



4

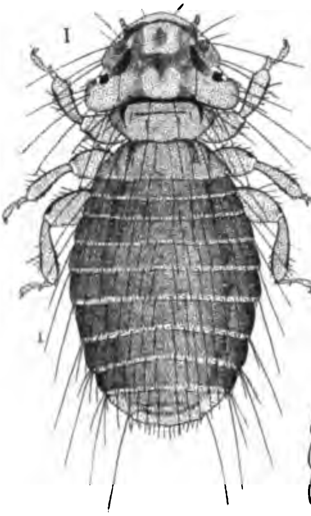


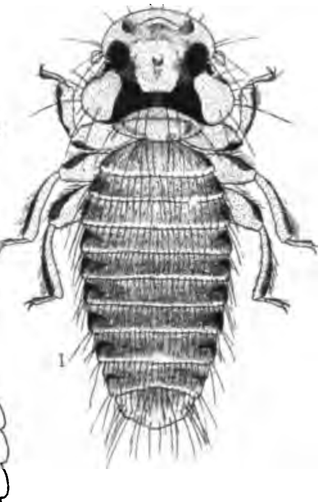
5

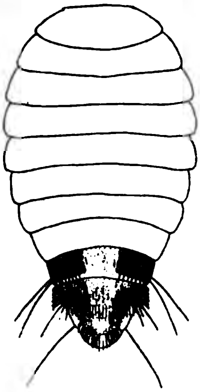


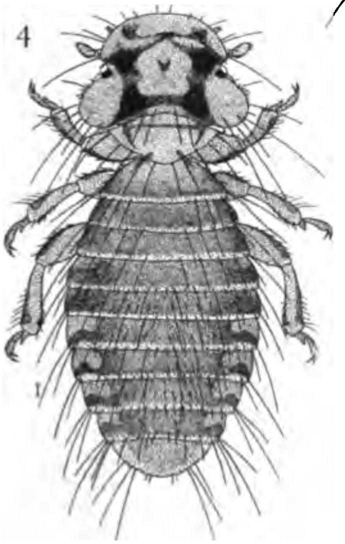
F. J. Jack Del.

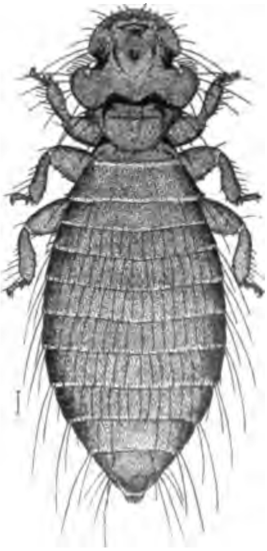
Lith. Britton & Rey, S.F.


1


2


3

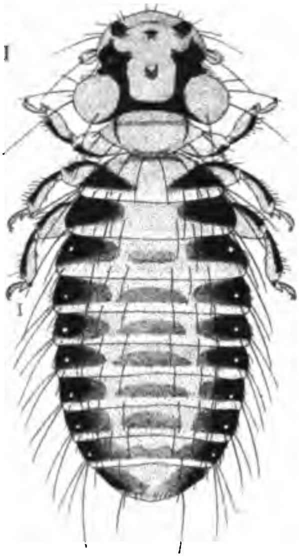

4


5

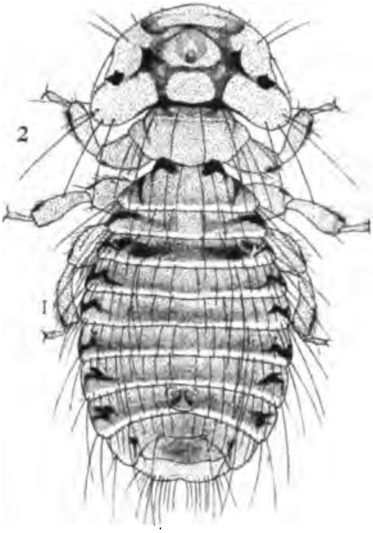
[illegible]   LITH. BRITTON & REY, S.F.

PLATE LXXII.

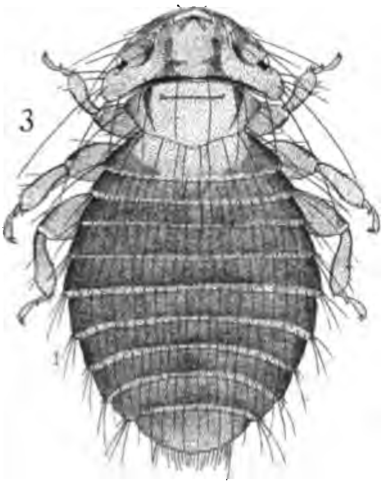
1



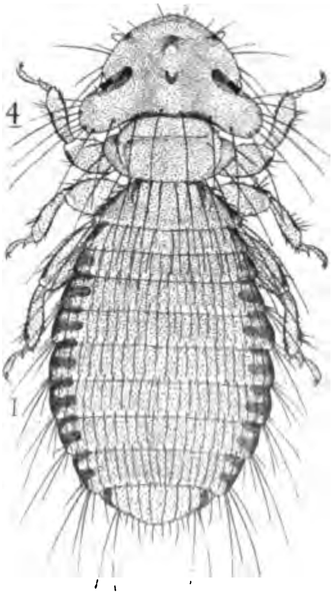
2



3

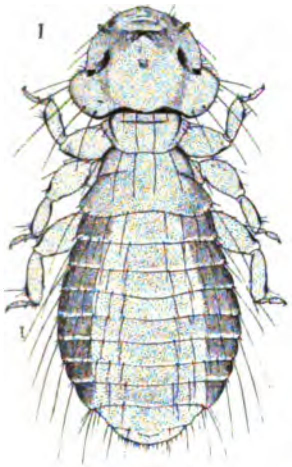


4

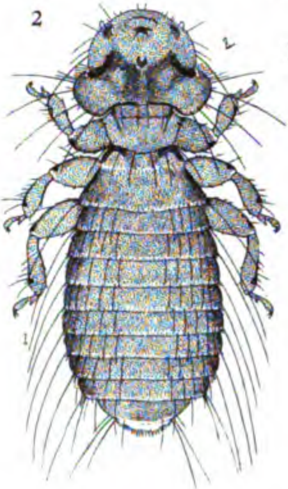


[illegible] [illegible]

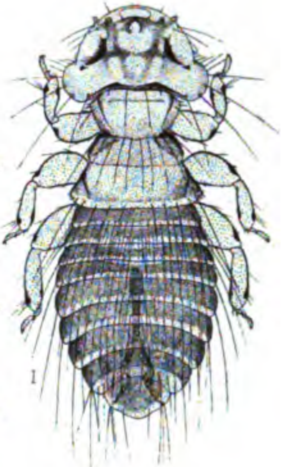
1



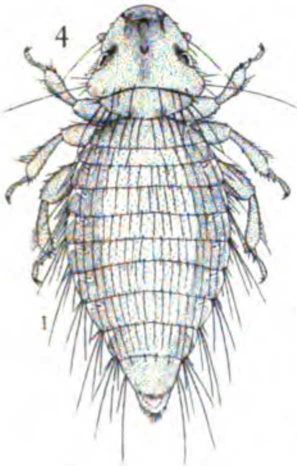
2



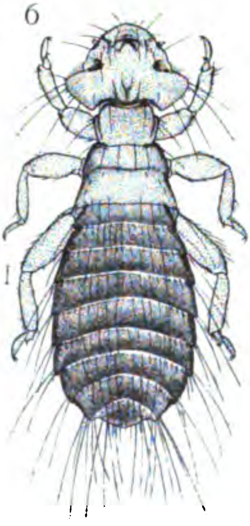
3



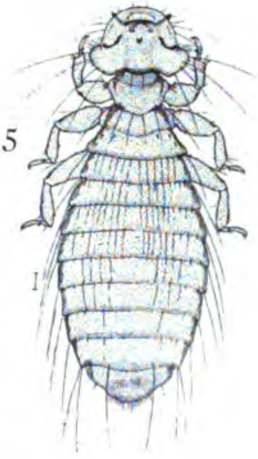
4



6



5



[illegible] del.

LITH. BRITTON & REY, S.F.

LELAND STANFORD JUNIOR UNIVERSITY PUBLICATIONS

CONTRIBUTIONS TO BIOLOGY

FROM

THE HOPKINS SEASIDE LABORATORY.

VIII

LIST OF FISHES COLLECTED AT PORT LUDLOW, WASH.

BY

EDWIN CHAPIN STARKS.

LELAND STANFORD JR. UNIVERSITY,
PALO ALTO, CALIFORNIA,
1896.

PREFATORY NOTE.

This memoir is the eighth of a series designed to illustrate the investigations and explorations of the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. The series is issued under the patronage of Timothy Hopkins, Esq., of Menlo Park, California. The present paper is published with the co-operation of the California Academy of Sciences, appearing simultaneously in its present form and as part of the Proceedings of the Academy.

CHARLES H. GILBERT,
OLIVER P. JENKINS,
Editors.

Date of publication, December 3, 1896.

LIST OF FISHES COLLECTED AT PORT LUDLOW, WASHINGTON.*

BY EDWIN CHAPIN STARKS.

(With Plates lxxiv and lxxv.)

This paper records the ichthyological results of the last annual dredging expedition made by the Young Naturalists' Association of Seattle, Washington, and the second in which the author, as an honorary member, has taken part. A camp was established this year near Port Ludlow, on Puget Sound, and all the dredging and other collecting was done in that vicinity.

The report of last year† recorded 141 species known from that region. Five new species and four others hitherto unrecorded are listed in the present paper.

The author wishes to express his indebtedness to Dr. Charles H. Gilbert, whose interest and aid made his work possible.

The following species are described here as new to science. The number after each is the number of the type on the register of the Leland Stanford Jr. University Museum. The new genus is indicated by full face type.

Neoliparis fissuratus. No. 5044.
Artedius asperulus. No. 5046.
Axyrias *harringtoni*. No. 5047.
Icelinus strabo. No. 5045.
Pallasina aix. No. 5040.

Family SQUALIDÆ.

1. **Squalus sucklii** (Girard).

---

*Contributions to Biology from the Hopkins Seaside Laboratory of the Leland Stanford Jr. University, No. 8.

†"The Fishes of Puget Sound," Jordan & Starks, Proc. Cal. Acad. Sci., 2d Ser., Vol. v, 1895.

Family RAJIDÆ.

2. **Raja binoculata** (Girard).

Family AMMODYTIDÆ.

3. **Ammodytes personatus** (Girard).

Hundreds of this species were found on the beach one morning at low tide.

Family SPHYRÆNIDÆ.

4. **Sphyræna argentea** (Girard).

Rather rare this far north, but not infrequently taken by the fishermen. Specimens are in the collections of the Young Naturalists that were taken in the vicinity of Seattle.

Family AULORHYNCHIDÆ.

5. **Aulorhynchus flavidus** Gill.

Very common. Several specimens taken with the seine from among the "eel grass."

Family GASTEROSTEIDÆ.

6. **Gasterosteus cataphractus** Pallas.

A few specimens seined on sandy beaches.

Family SYNGNATHIDÆ.

7. **Siphostoma griseolineatum** (Ayres).

Rather common. A dozen or so specimens taken in the seine.

Family STROMATEIDÆ.

8. **Rhombus simillimus** (Ayres).

One specimen seen.

Family EMBIOTOCIDÆ.

9. **Cymatogaster aggregatus** Gibbons.

Family SCORPÆNIDÆ.

10. **Sebastodes caurinus** (Richardson).

Family HEXAGRAMMIDÆ.

11. **Hexagrammus asper** Steller.

12. **Ophiodon elongatus** Girard.

Family COTTIDÆ.

13. **Chitonotus pugettensis** (Steindachner).

One specimen dredged.

14. **Icelinus strabo** Starks n. sp.

Head 2¾ in body; depth 4; D. IX–15; anal 13; eye 4 in head; maxillary 2⅖; snout 4.

Body robust at shoulders, tapering into a rather slender caudal peduncle; upper profile of head evenly curved from snout to dorsal, the snout rather steep; mouth horizontal and placed at the extreme lower aspect of head; upper jaw projecting slightly beyond the lower; narrow bands of villiform teeth on jaws, vomer, and palatines; maxillary reaching about to posterior margin of eye.

Nasal spines prominent; upper spine of preopercle longer than eye, extending upward and backward, and bearing on its inner edge one or two antler-like processes; below it on edge of preopercle are two small spines, the upper rather blunt and not conspicuous, the lower longer and sharp, pointing downward and somewhat forward; on each side of occiput is a small blunt tubercle, a short dermal flap behind each eye, and one sometimes present behind each occipital tubercle.

Head naked; a band of scales along back, following dorsal outline, composed of two rows of scales for most of its length, but the posterior five or six scales are in a single row; the outer and anterior edge of each scale is embedded, the inner and posterior edge is strongly ctenoid, so the opposing edges of the rows are ctenoid edges; a single row of 37 scales along lateral line, the anterior ones rougher than the others.

Dorsal spines slender, the fins not connected; front of anal slightly nearer tip of snout than base of caudal; pectorals rather wide, reaching a little past front of soft dorsal.

Color olive-gray, with faint irregular darker cross-bars on back, the first under middle of spinous dorsal, the second under first fourth of soft dorsal, the third under last fourth of soft dorsal, indications of one on caudal peduncle, and a dark streak at base of caudal fin; sides and back mottled, under parts white; ventrals and anal white, other fins crossed with dark wavy lines,

This species is closely related to *Icelinus borealis*, differing from it in having a smaller eye, a stouter caudal peduncle, a slightly wider interorbital space, shorter barbels behind eye, the barbels at occiput not so constant in their presence, and in having the end of maxillary in a different relation to the eye.

The eye of *Icelinus borealis* is contained only three times in the length of the head in specimens of the same size as *Icelinus microps*, and the maxillary scarcely reaches past pupil. This comparison is based on specimens of *I. borealis* taken by the "Albatross" in the Straits of Fuca and in Bristol Bay, Alaska.

About twenty-five specimens taken near Port Ludlow with the dredge, the largest an inch and a half in length.

The types are in the collection of Leland Stanford Jr. University, bearing the number 5045.

15. **Triglops beani** Gilbert.

One specimen dredged.

16. **Artedius asperulus** Starks n. sp.

Head 2¾ in body; depth 4; D. IX–16; A. 12; eye 4 in head; maxillary 2⅓; snout 4.

Profile of head broadly rounded from tip of snout to occiput, the snout very steep; lower outline of head nearly horizontal, mouth at lower aspect of head little if any oblique; maxillary reaching to below middle of eye; villiform teeth on jaws, vomer, and palatines; nasal spines prominent, preopercular process short, bifurcate, the entire spine covered with skin; three small spines developed on edge of preopercle below it; top of head naked, with many mucous pores; interorbital space narrow, concave, its width about half eye. A wide band of strongly ctenoid scales along back, starting opposite front of spinous dorsal, and below it a distance equal to pupil, gradually running upward and nearly touching the base of soft dorsal, joining its fellow of the opposite side behind dorsal, and continuing on caudal peduncle to midway between last ray of dorsal and base of caudal; at its widest part, under front of soft dorsal, it is 9 scales wide in an oblique series; 33 oblique series in its length; lateral line armed with 35 ctenoid scales in a single series; all the scales are imbedded on their lower anterior edges and ctenoid on their upper posterior edges; naked area between lateral line and band of scales, at its widest part narrower than band of scales. Spinuous dorsal rounded in outline, not joined to soft dorsal; pectoral reaching to base of seventh or eighth ray of soft dorsal; ventrals reaching vent.

Color olive-brown, with four or five dark, irregular cross-bars on back, which break up and form reticulations around white spots on sides; the lower of these spots form semicircles only where they run into the white of the belly. The first cross-bar is under front of spinous dorsal, the second is under front of soft dorsal, the third under posterior third of soft dorsal, the fourth indicated by a blotch on caudal peduncle; a dark streak at base of caudal fin; under parts white; ventrals and anal white, other fins crossed with undulating lines; lips dusky.

This species differs from *Artedius lateralis*, with which it seems to be most closely related, in having a wider and longer band of scales, and in other less important characters.

The types are three specimens about an inch and a half in length, which were dredged in the vicinity of Port Ludlow. They are in the museum of the Leland Stanford Jr. University, No. 5046.

Axyrias n. gen.

Top of head with patches of ctenoid scales and cirri. A band of very small scales below dorsals, and a single row of larger ones following the lateral line. Villiform teeth on jaws, vomer, and palatines. Preopercular spine short, very narrowly forked. Dorsals not connected. Gill-membranes united, free from the isthmus. No slit behind last gill. Ventrals I, 3.

This genus seems to be related to *Artedius*, *Chitonotus* and *Astrolytus*. It differs from *Artedius* in the rough head and smaller scales, and from *Astrolytes* and *Chitonotus* in the single fork to the preopercular spine, and in the smaller scales.

(*ἀξυρίας*, one unshorn: *ξυρίας*, a shaveling.)

17. **Axyrias harringtoni** Starks n. sp. Plate lxxiv.

Head $2\frac{2}{3}$ in length of body; depth $4\frac{1}{6}$; dorsal IX–16; anal 12; eye 4 in head; maxillary $2\frac{1}{2}$.

Upper profile of head steep from tip of snout to above eyes, thence nearly horizontal; mouth at lower aspect of head, the jaws subequal; maxillary reaching to the vertical from pupil; villiform teeth on jaws, vomer, and palatines; eye set high in head, its diameter a little less than length of snout; interorbital space nearly concave, its width about half eye; upper preopercular spine short, its length about a third of eye, very narrowly bifurcate at tip, the forks very small; below it on edge of preopercle is a second spine, small and blunt, and a third scarcely developed; nasal spines prominent. Top of head and upper part of opercles with patches of ctenoid scales, a patch on posterior part of interorbital space and behind eyes, sending a narrow band backwards along each side of head above opercles, and a few in front of dorsal, leaving a seminaked area in front of occiput, which has a few scales scattered over it. Many cirri on top of head scattered among the scales, one above posterior edge of each eye, one over anterior edge of eye, two or three around edge of preopercle, one on end of maxillary, and one at each anterior lateral scale back to about middle of lateral line. A band of rough scales along back, about 7 scales wide anteriorly, and composed of about 47 oblique series; the scales obliquely imbedded, the upper posterior edges strongly ctenoid, the lower anterior edges imbedded. A naked area of nearly the same width as band between it and spinous dorsal, the band running upwards posteriorly and touching second dorsal at about its middle, running back and joining its fellow of the opposite side behind the second dorsal, and ending midway between base of last ray and base of caudal; a single row of 36 scales similar to the others following lateral line. Dorsal spines subequal from the first to the sixth or seventh, the fin not connected with soft dorsal, which is about the same heighth as the spinous; pectoral rather large, reaching to the base of fourth or fifth dorsal ray; ventrals scarcely reaching vent; insertion of anal midway between middle of eye and base of caudal, its longest ray about equal to those of dorsal.

Ground color olive, with about five dark cross-bars on back; the first bar under middle of spinuous dorsal, the second under front of soft dorsal, the third under its middle, and the fourth under its end, and the fifth is represented by a blotch on top of caudal peduncle; a dark streak at base of caudal fin; sides with many clear-cut, round, white spots, growing larger downwards; the lower row are only half spots where the white of the spot runs into the white on lower part of body; belly white; lips and under parts of head with dark olive-brown wavy bars of about the same width as the interspaces; fins with wavy dark streaks, except anal and ventrals which are white. Coloration very similar to *Artedius lateralis*.

The single type specimen was taken with the dredge in the vicinity of Port Ludlow. It is about two and a half inches in length. Numbered 5047 on the register of the museum in Leland Stanford Jr. University. I take pleasure in naming this species for President Mark Walrod Harrington of the University of Washington.

18. **Hemilepidotus hemilepidotus** (Tilesius).

19. **Acanthocottus polyacanthocottus** (Pallas).

Abundant; specimens were taken with the seine and set line. These specimens have a smaller eye and shorter preopercular spine than specimens from Alaska; but both of these characters are so variable that it does not seem possible to separate them.

The following is the fin formula of our specimens:

	1 specimen.	1 specimen.	6 specimens.	4 specimens.
Dorsal	viii—13	viii—14	ix—13	ix—13
Anal	11	11	11	12

	2 specimens.	3 specimens.	1 specimen.	1 specimen.
Dorsal	ix—14	ix—14	x—13	x—13
Anal	11	12	11	12

20. **Enophrys bison** (Girard).

21. **Leptocottus armatus** Girard.

22. **Oligocottus embryum** Jordan & Starks.

A few specimens were taken in the rock pools. The color was found very variable, as in related species, running from a grass green without distinct markings to those that are mottled and barred, as described in original description.

23. **Oligocottus borealis** Jordan & Snyder.

Very abundant in tide pools.

24. **Nautichthys oculofasciatus** (Girard).

A few specimens taken in the dredge.

25. **Blepsias cirrhosus** (Pallas).

Very abundant in the "eel grass," where specimens were secured.

26. **Ascelichthys rhodorus** Jordan & Gilbert).

A large specimen found under a rock on the shores of

Mats Mats Bay, and a small one dredged from moderately deep water.

Family PSYCHROLUTIDÆ.

27. **Psychrolutes paradoxus** Günther.
(*Psychrolutes zebra* Bean.)

First recorded last year from this locality, where a single small specimen was dredged. This year it was found to be extremely abundant, and was taken with the seine and dredge.

According to Dr. Boulenger, the original type of *P. paradoxus* agrees perfectly with our figure of *P. zebra*, and the two are not distinct.

Family RHAMPHOCOTTIDÆ.

28. **Rhamphocottus richardsoni** Günther.

A few small specimens taken with the dredge.

Family AGONIDÆ.

29. **Aspidophoroides inermis** Günther.

One specimen dredged.

30. **Pallasina aix*** Starks n. sp. Plate lxxv.

Head from tip of snout 4 in body; depth 3½ in head; dorsal VII–7; anal 11; pectoral 11; eye 5⅓ in head.

Mouth rather oblique, the lower jaw much projecting; upper edge of maxillary slipping under preorbital for its whole length, its posterior end midway between tip of snout and middle of eye; villiform teeth on jaws and vomer, none apparently on palatines; lower jaw with a fleshy tip, scarcely produced into a barbel, scarcely as long as diameter of pupil; supraorbital rim prominent, making the interorbital space deeply concave; width of the latter about two-thirds eye; two ridges from the inner edges of supraorbital rim run backward, and are continuous with dorsal ridges of body; edge of preopercle with three spines, the middle one the largest. Two large median plates in front of ventrals on breast, a row of plates along each lateral ridge of breast, a large plate on each side of the union between first and second median plates, and behind them a row of small plates irregular in size and position, sometimes continuous and interposed between median and lateral plates, and sometimes allowing the edges of median and lateral plates to touch; 11 or 12 plates in front of dorsal; spinous dorsal on 9 or 10 plates, counting to end of membrane; lateral line 43. Space between dorsal ridges strongly concave, the ridges coming together on caudal peduncle but not uniting, continuing parallel for a short distance and then becoming obsolete; upper lateral ridge ending anteriorly on about the twelfth plate from head. Last rays of dorsal and anal connected to the body by a membrane; space between dorsals about equal to the width of a plate; front of anal midway between posterior end of maxillary and base of caudal; pectoral reaching just past front of spinous dorsal; vent distant an eye's diameter from base of ventrals; length of caudal equal to head behind anterior ridge of pupil.

---

*ἀίξ, a goat, from the pointed beard, or ᾀίξ, a darter from the slender form.

Color blackish, with fine punctulations; belly white; a light streak running backward from eye to upper edge of gill-opening; below this an area scarcely so wide as eye, darker than the rest of body, its lower edge sharply defined against the white under parts of head; chin black; dorsals and caudal dusky; pectorals light, the rays with many black spots which do not involve the membrane; ventrals and anal white.

This species differs from *Pallasina barbatus* in having a much shorter barbel on chin, in having two median plates in front of ventrals in place of three, and in having the plates between the median and lateral plates much smaller and less regular in arrangement. In *P. barbatus* these plates are about as large as the median plates and always interposed between them and lateral plates, the arrangement being constant. The abdominal ridges are generally closer together in *P. aix* than in the northern species.

This species was taken with the seine in great abundance in Puget Sound, near Port Ludlow; the largest is nearly five inches in length, the others about three.

This type has been given the number 5040 on the register of the collection in the Leland Stanford Jr. University Museum.

31. **Podothecus acipenserinus** (Pallas).

Two small specimens obtained in the seine.

32. **Averruncus emmelane** Jordan & Starks.

A fine large specimen taken with the seine.

33. **Xystes axinophrys** Jordan & Starks.

Two specimens seined, about the same size as the single type specimen, 1½ inches in length.

34. **Odontopyxis trispinosus** Lockington.

Rather common. A few specimens secured with the dredge.

Family LIPARIDIDÆ.

35. **Neoliparis fissuratus** Starks n. sp.

Head 3¼ in body; depth 4½; dorsal VI–28; anal 26; pectoral 36; caudal 14; eye 7 in head; maxillary 2⅛; ventral disk 2½.

Body moderately elongate, not produced at nape; mouth rather large, the maxillary extending to below middle of eye; jaws subequal; teeth tricuspid, arranged in about 10 oblique series in each jaw; nostrils ending in short wide tubes; gill-openings wider than in any other known *Neoliparis*, commencing a distance above pectoral about equal to the diameter of eye, ending about opposite the fourteenth ray; ventral disk a little longer than wide, its distance from chin equal to one and a half its longest diameter, its posterior edge about the same distance from front of anal; vent nearer anal than ventral disk, its distance from anal equal to half ventral disk. Origin of spinous dorsal at the vertical from midway between vent and ventral disk; dorsal scarcely joined to caudal, anal very slightly; front of anal nearer chin than base of caudal by a distance equal to ventral disk; pectoral rather short and wide, reaching to opposite front of anal, the lower lobe very narrow and long, much longer than upper lobe, but not reaching so far posteriorly on account of the oblique position of the fin; tip of lower lobe reaching to vent; length of caudal 1$\frac{3}{5}$ in head.

Color dusky, darker above, sides with five punctulations, belly and under parts of head except chin white; lips dusky; dorsals and anal darker than body; pectoral dusky at base, the lower lobe dark; caudal crossed with wavy dark lines.

This species differs from the other species in this genus in having a wider gill-opening, and in minor characters.

The single type specimen was taken with the dredge, in the vicinity of Port Ludlow; it is 2¼ inches in length. It bears the number 5044 on the register of the Leland Stanford Jr. University collection.

36. **Liparis dennyi** Jordan & Starks.

One specimen dredged.

37. **Liparis fucensis** Gilbert.

Three specimens dredged.

38. **Liparis pulchellus** Ayres.

Three small specimens taken with the dredge.

Family GOBIESOCIDÆ.

39. **Caularchus mæandricus** (Girard).

Family XIPHIDIONTIDÆ.

40. **Pholis ornatus** (Girard).

41. **Apodichthys flavidus** Girard.

Obtained in great abundance with the seine from among the *Fucus*. No specimens seen in the rock pools.

42. **Anoplarchus atropurpureus** (Kittlitz).

43. **Xiphistes chirus** Jordan & Gilbert.

44. **Xiphidion rupestre** (Jordan & Gilbert).

45. **Xiphidion mucosum** Girard.

Family STICHÆIDÆ.

46. **Lumpenus anguillaris** (Pallas).

A few large ones taken. The young of this species was one of the most abundant taken with the seine.

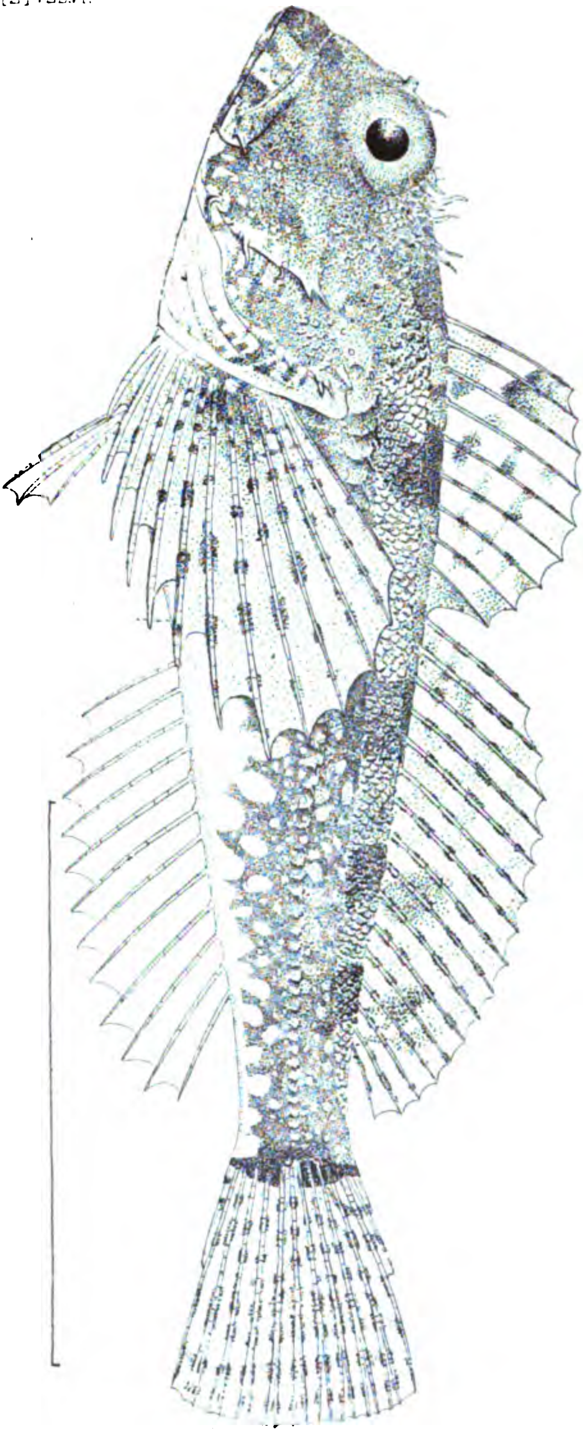
Family GADIDÆ.

47. **Microgadus proximus** (Girard).

Family PLEURONECTIDÆ.

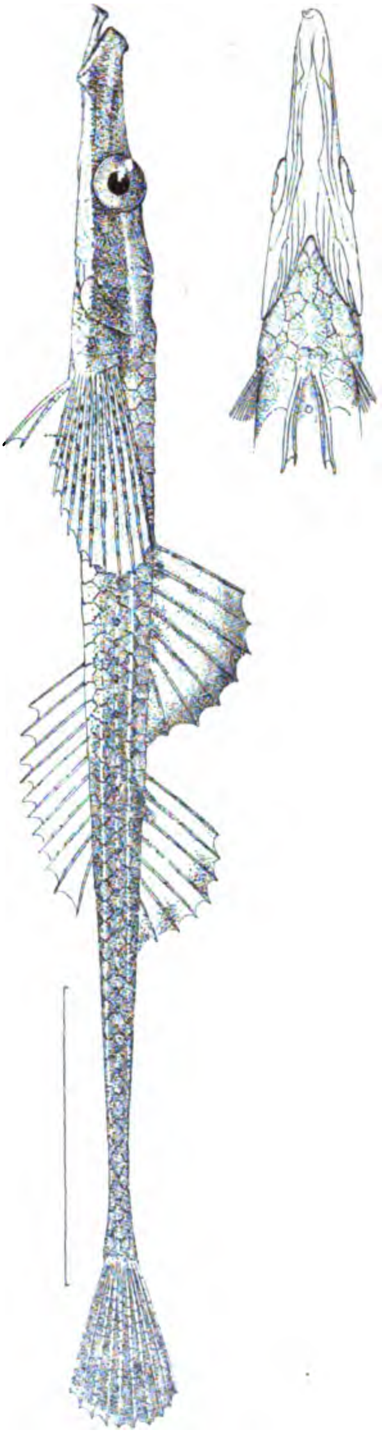
48. **Lepidopsetta bilineata** (Ayres).

49. **Platichthys stellatus.**



AXYRIAS HARRINGTONI.

[illegible]



PALLASINA AIX.

LITH. BRITTON & REY, S.F.

Prefatory Note.

This memoir is the ninth of a series designed to illustrate the investigations and explorations of the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. The series is issued under the patronage of Timothy Hopkins, Esq., of Menlo Park, California. The present paper is published by the American Philosophical Society, appearing simultaneously in its present form and as a part of the Proceedings of that Society.

CHARLES H. GILBERT,
OLIVER P. JENKINS,
Editors.

DATE OF PUBLICATION: JANUARY 7, 1897.

LELAND STANFORD JUNIOR UNIVERSITY PUBLICATIONS.

# CONTRIBUTIONS TO BIOLOGY
FROM
THE HOPKINS SEASIDE LABORATORY.

IX.

Marine Fossils from the Coal Measures of Arkansas.

...BY...

JAMES PERRIN SMITH.

Reprint from the Proceedings of the American Philosophical Society,
Vol. xxxv, No. 152.

LELAND STANFORD JR. UNIVERSITY,
PALO ALTO, CALIFORNIA,
1896.

CONTENTS.

PAGE.

Preface by J. C. Branner........ 4
Introduction........ 4
Localities Discovered by the Survey........ 5
  Lower Coal Measures........ 6
  Upper Coal Measures........ 9
  Fayetteville Shale........ 11
Comparison with the Permo-Carboniferous of Kansas and Nebraska 11
Relations to the Texas Upper Carboniferous........ 13
Comparison with Foreign Upper Carboniferous........ 13
  The Lo-ping Fauna of China........ 13
  The Salt Range Beds of India........ 14
  The Itaitúba Fauna, Brazil........ 15
Classification and Age of the Arkansas Coal Measures........ 15
  Provisional Classification........ 15
  The Lower Coal Measures........ 16
  The Upper Coal Measures........ 16
  Paleobotanic Evidence........ 17
The Pacific Carboniferous Sea........ 18
  Revolution in Devonian Times........ 18
  The Carboniferous Sea........ 19
  Upper Carboniferous in the West........ 20
  The Pawhuski Limestone........ 20
  Interchange of Life between East and West........ 21
  Replacement of Limestones by the Coal-bearing Formations in Western Europe........ 22
  Land Areas in the West........ 22
The Permian Pacific Ocean........ 22
The Triassic Pacific Ocean........ 23
Time of the Ouachita Uplift........ 23
Correlation Table of the Coal Measures of Arkansas........ 24
Descriptions of the Coal Measure Marine Fossils........ 25
Tabulated List of the Marine Fossils of the Coal Measures of Arkansas........ 64
Explanation of Plates........ 73

Plate xvi.
Plate xvii.
Plate xviii.
Plate xix.
Plate xx.
Plate xxi.
Plate xxii.
Plate xxiii.
Plate xxiv.

PREFACE.

The Coal Measures cover an area of 14,700 square miles in the State of Arkansas. The greater part of this area lies in the geosyncline of the Arkansas Valley. The total thickness of the sediments in this geosyncline is enormous—24,000 feet. These conditions, taken in connection with the occurrence in these sediments of both land plants (coal beds) and of marine fossils seem to show that the beds were deposited upon a subsiding (for the most part) floor, and that the land stood near the sea level, below which it occasionally sank.

The marine fossils from the Coal Measures area, so far as they were collected by the Geological Survey of Arkansas, are listed and described in the following paper kindly prepared at my request by Dr. J. P. Smith, of Stanford University. It is volunteer work done originally for the State Survey, and was to have been published in a volume upon the paleontology of Arkansas. Upon the abolition of the Survey by the Legislature in 1893 several volumes of reports were left unpublished, and among them one on the paleontology of the State.

JOHN C. BRANNER,
Late State Geologist of Arkansas.

Stanford University, California, July 10, 1896.

INTRODUCTION.

Marine fossils afford the best means of correlating strata of different regions, but in the Coal Measures they are usually rare, and therefore of especial interest and value when found.

Of all the Paleozoic systems the Carboniferous is most subject to facies variations, which make it difficult and often impossible to recognize with certainty the minor subdivisions at any great distance from the place where they were first established This is true even of the Mississippian formation, whose limestones were deposited under comparatively uniform conditions, so that one would expect the faunal relations to be the same over the whole area where the Mississippian facies prevails. But the American Coal Measures were formed under conditions not favorable to uniformity either of rock character or of life, hence the correlation of these strata becomes more difficult. And in these geologists have been more prone to rely on lithologic characters and unaided stratigraphy. Such correlations have only a local value, and cannot be extended over any wide scope of territory. For this reason no divisions of the Coal Measures into zones has every been carried out, nor can it be done, in the present state of our knowledge.

Previous to the collections made by the Geological Survey of Arkansas, marine fossils were known from but a single locality in the Coal Measures of Arkansas. Dr. David Dale Owen, in his *Geological Reconnoissance of Arkansas*, Vol. i, p. 68, says: "Three miles northwest of Searcy, at a 'bald point,' in the vicinity of the widow Gilbert's farm, sixty feet of shaly strata are exposed, dark or nearly black, in its lower part, and reddish yellow and ferruginous towards the top. The shale includes numerous segregations of carbonate of iron and carbonate of lime; the latter containing several fossil marine shells, amongst which the *Nautilus ferratus* was discovered, a species which occurs in the ferruginous shales of Nolin, in Edmonson county, Ky." The locality mentioned is now known to be in the Lower Coal Measures, and is situated not three but thirteen miles northwest of Searcy.

F. B. Meek, in the *Final Report of the U. S. Geological Survey of Nebraska*,* mentions *Hydreinocrinus* (*Zeacrinus*) *mucrospinosus* McChesney, from the Coal Measures of Arkansas, but he does not cite any authority for the statement, nor does he say he has seen this fossil from Arkansas, or give any locality. In all the other literature where this species is mentioned, nothing is said about Arkansas. It is, therefore, concluded that this species was never found in the State. It was, however, found by the Geological Survey, in strata of the Upper Coal Measures, on Poteau mountain, Indian Territory, two miles west of the line of Scott county, Arkansas.

Featherstonhaugh† mentioned a "new species of pentremite in the old red sandstone of Maumelle." The strata of Maumelle mountain, Pulaski county, are of Lower Coal Measure age, and it is not likely that a pentremite was ever found there, since the systematic searches of the Survey failed to find any fossils in this region.

LOCALITIES DISCOVERED BY THE SURVEY.

Marine Coal Measure fossils were found by the Survey at twenty-one different places, besides that mentioned by Owen. These extend from Independence county westward to Indian Territory, giving a total of forty-eight genera and ninety species, forty-eight in the Lower Coal Measures, and fifty-two in the Upper, with ten species common to both. It is not thought that this small number of species represents the entire fauna, or that only ten species are common to the two divisions, for the collections were much too scattered and meagre to exhaust the possibilities. But the fauna is a poor one, such as one would expect to wander in from deeper waters whenever a slight subsidence made the shallow waters a little more habitable. The faunas could not become well established, because the conditions soon reverted to their old state, and the inhabitants of the seas were forced to migrate or be exterminated.

There is, therefore, in this region no gradual transition from the fauna of the Lower Carboniferous limestone, and the fossils of the Lower Coal Measures are just as different from those of the Lower Carboniferous as are those of the Upper Coal Measures.

It is not attempted to carry the division further than into Upper and

---

* Op. cit., p. 149.

† *Geolog. Rep. Elevated Country between the Missouri and Red Rivers*, p. 61.

Lower Coal Measures, and even this division is often uncertain, for in most cases the relations of the fossiliferous beds to each other could not be determined with any degree of certainty. Also in most of this region the stratigraphy is difficult; the rocks vary so little, and are so folded and faulted that by stratigraphy alone it was often impossible to locate a bed within several hundred feet.

In addition to this, the number of the species is usually too small, and their character too indecisive to enable one to say with certainty to which division the strata belonged. Therefore, in enumerating the localities there are given only the character of the rocks, the fossils found in them, and the place in the section where these strata are thought to belong.

Lower Coal Measures.

Of these localities there were seventeen discovered, and they will be given in order from east to west.

No. 1. Independence county, 11 N., 5 W., section 9, centre of the section. Soft brownish sandstone with *Euomphalus* (*Straparollus*) sp.; near the middle of the Lower Coal Measures. Collector, J. C. Branner.

No. 2. White county, 8 N., 7 W., section 26, Bee Rock on Little Red river. Massive yellowish sandstone, over one hundred feet exposed, nearly horizontal; at the top with marine fossils, at the bottom with plants. Near the base of the Lower Coal Measures. Collector, J. P. Smith.

Crinoid stems.
Productus semireticulatus Martin.
Spirifer rockymontanus Marcou.
Aviculopecten carboniferus Stevens.
Bellerophon sp.
Plant remains, undetermined.

No. 3. White county, 8 N., 7 W., section 33, east half of southeast quarter, south of Norton's field, on the road from Searcy to Griffin Springs. Hard yellowish and in places ferruginous sandstone, with a dip of about 30° south. Horizon same as the last locality. Collector, J. P. Smith.

Fenestella sp.
Orthis conf. *resupinoides* Cox.
Productus semireticulatus Martin.
Rhynchonella sp.
Spirifer rockymontanus Marcou.
Schizodus conf. *amplus* Meek and Worthen.
Bellerophon sp.

No. 4. White county, 9 N., 4 W., section 6. Soft pinkish sandstone. Near middle of Lower Coal Measure. Collector, J. C. Branner.

Phillipsia (*Griffithides*) *scitula* Meek and Worthen.
Euomphalus (*Straparollus*) *subquadratus* Meek and Worthen.
Athyris subtilita Hall.
Prestwichia sp. or a new genus closely allied to *Prestwichia*.

No. 5. White county, 9 N., 5 W., section 1. Soft reddish sandstone, similar to that of locality No. 4, containing also *Phillipsia* (*Griffithides*) *scitula* Meek and Worthen. Collector, J. C. Branner.

No. 6. Lonoke county, 4 N., 10 W., section 12, southeast quarter of northwest quarter. Gray quartzite conglomerate seen in a well by the roadside to dip 45° south. Towards base of Lower Coal Measure. Collector, J. P. Smith.
Crinoid stems, undetermined.

No. 7. Conway county, 6 N., 16 W., section 29, southwest quarter of southwest quarter, on east bank of Arkansas river, about one mile below the Old Lewisburg ferry. A brown ferruginous shale near the top of the Lower Coal Measures and probably a few hundred feet above the shales of locality No. 8. Collector, J. F. Newsom.
Productus punctatus Martin.
Derbyia crassa Meek and Hayden.
Orthis pecosii Marcou.
Spirifer cameratus Morton.
Spiriferina cristata Schlotheim.
Athyris subtilita Hall.
Terebratula hastata Sowerby.
Aviculopecten occidentalis Shumard.

No. 8. Conway county. 5 N., 16 W., section 17, two hundred yards west of the centre of northwest quarter, west of the Arkansas river, and four miles south of Morrillton. The horizon is near the top of the Lower Coal Measures. Reddish ferruginous shale. Collector, J. F Newsom.
Phillipsia (*Griffithides*) *ornata* Vogdes.
Zaphrentis sp.
Nucula parva McChesney.
Nucula ventricosa Hall.
Macrodon carbonarius Cox.
Conocardium aliforme Sowerby.
Aviculopecten occidentalis Shumard.
Aviculopecten carboniferus Stevens.
Pleurophorus oblongus Cox.
Bellerophon carbonarius Cox.
Bellerophon crassus Meek and Worthen.
Pleurotomaria sp.
Macrocheilus (*Soleniscus*) conf. *primigenius* Conrad.
Macrocheilus conf. *fusiformis* Hall.
Goniatites (*Paralegoceras*) *iowensis* Meek and Worthen.

Nautilus (*Ephippioceras*) *ferratus* Cox.
Nautilus (*Endolobus*) *missouriensis* Swallow.

No. 9. Conway county, 7 N., 16 W., section 8, northeast quarter of northeast quarter, about two hundred yards east of the centre; one hundred yards northwest of the iron bridge. Ferruginous, porous sandstone, full of poorly preserved casts of fossils, that could not be specifically identified. This horizon lies about one thousand feet below that of locality No. 7, near Old Lewisburg, and is probably the same as that of locality No. 10, Cook's quarry, near Hattieville. Collector. J. F. Newsom.

Zaphrentis (?).
Crinoid stems.
Spirifer sp.
Euomphalus sp.

No. 10. Conway county, 8 N., 17 W., section 33, northeast quarter of northeast quarter, Cook's quarry, near Hattieville. Hard yellowish sandstone. Upper part of Lower Coal Measures. Collector. J. F. Newsom.

Orthoceras sp.
Astartella newberryi Meek.
Aviculopecten occidentalis Shumard.
Edmondia unioniformis Phillips.
Schizodus wheeleri Swallow.
Schizodus cuneatus Meek.
Bellerophon carbonarius Cox.
Pleurotomaria harii S. A. Miller.
Pleurotomaria sp.
Euomphalus sp.
Orthoceras sp.
Orthis resupinoides Cox.
Orthis sp.
Terebratula hastata Sowerby.

No. 11. Pope county, 10 N., 20 W., section 8, southeast quarter of northwest quarter. Ferruginous shale like that near Morrillton. Collector, H. E. Williams.

Crinoid stems.
Pleurotomaria sp.
Goniatites (*Gastrioceras*) *excelsus*, Meek.

No. 12. Johnson county, 11 N., 24 W., section 26, southwest quarter of southwest quarter. Brownish ferruginous sandstone. Collector, A. G. Taff.

Phillipsia sp.

No. 13. Franklin county, 11 N., 27 W., section 4, southeast quarter of northeast quarter. Weathered ferruginous sandstone. Collector, A. G. Taff.

Crinoid stems.
Spirifer sp.

No. 14. Franklin county, 10 N., 26 W., section 2, southeast quarter of southeast quarter. Ferruginous sandstone. Collector, A. G. Taff.

Bellerophon carbonarius Cox.

No. 15. Franklin county, 11 N., 28 W., section 27, northeast quarter of southeast quarter Ferruginous sandstone. Collector, A. G. Taff.

Pleurotomaria sp.

No. 16. Crawford county, 12 N., 30 W., section 17, northeast quarter of southeast quarter. Brownish sandstone, very like that of Bee Rock, White county. Collector, E. C. Buchanan.

Spirifer rockymontanus Marcou.

No. 17. Carroll county, 17 N., 19 W., northeast corner of section 18; Pilot mountain, three and a half miles southwest of Valley Springs. Millstone grit, about sixty feet above a brownish limestone supposed to represent the Chester horizon. Collector, Stuart Weller.

Gastrioceras branneri n. sp. J. P. Smith.
Pronorites cyclolobus Phillips, var. *arkansiensis* nov. var. J. P. Smith.

Upper Coal Measures.

In the Upper Coal Measures, three localities were discovered by the Survey, giving fifty-two species, of which thirty-two were found on Poteau mountain, Indian Territory.

No. 1. Scott county, 1 N., 28 W., section 4, southeast quarter of southeast quarter. Yellow ferruginous shale, with fossils in hard nodules. This horizon is probably equivalent to the Canyon division of Texas, lower part of Upper Coal Measures, since many similar fossils were found in that horizon by the Geological Survey of Texas. Collector, C. E. Siebenthal.

Cyathocrinus (?).
Conularia conf. *crustula* White.
Naticopsis sp.
Nuculana aff. *bellistriata* Stevens.
Pleurophorus sp.
Goniatites (*Gastrioceras*) sp. indet.
Goniatites (*Gastrioceras*) *globulosus* Meek and Worthen.
Goniatites (*Gastrioceras*) *marianus* Verneul.
Goniatites (*Pronorites*) sp.
Orthoceras conf. *rushense* McChesney.

While the stratigraphy seems to place these beds in the Lower Coal Measures, the fossils are decidedly Upper Coal Measure forms, and are characteristic of that horizon in Texas, Kansas, etc.

No. 2. Crawford county, 10 N., 30 W., section 10, southeast quarter of northwest quarter. Soft ferruginous shale. Collector, C. E. Siebenthal.

Zaphrentis sp.
Rhynchonella sp.
Macrodon sp.
Dentalium conf. *meekianum* Geinitz.
Polyphemopsis inornatus Meek and Worthen.
Pleurotomaria modesta Keyes.
Nautilus sp.

No. 3. Sebastian county, 8 N., 32 W., section 12. Ferruginous shale near Mr. Wilson's house. High up in Upper Coal Measures. Collector, Arthur Winslow.

Crinoid stems.
Fistulipora nodulifera Meek.
Athyris subtilita Hall.
Productus splendens Norwood and Pratten.
Retzia mormonii Marcou.
Spirifer cameratus Morton.
Spiriferina cristata Schlotheim.
Macrodon obsoletus Meek.
Nucula parva McChesney.
Bellerophon carbonarius Cox.
Bellerophon marcouanus Geinitz.
Naticopsis nana Meek and Worthen.
Pleurotomaria sp.

No. 4. Poteau mountain, Indian Territory, two miles west of the Scott county, Arkansas, line, on the east fork of Sugar creek, 150 feet below the southern crest of the mountain. The fossiliferous bed is a soft gray shale about four inches thick. About 1000 feet of shales lie above this, but no fossils were found in them. The fossiliferous bed is several hundred feet above the highest bed of coal known in that region.

The following fossils were collected here by C. E. Siebenthal:

Lophophyllum proliferum McChesney.
Erisocrinus (*Ceriocrinus*) *inflexus* Geinitz.
Hydreinocrinus mucrospinosus McChesney.
Poteriocrinus (?).
Orthis pecosii Marcou.
Derbyia crassa Meek and Hayden.
Productus cora d'Orbigny.
P. splendens Norwood and Pratten.
Rhynchonella uta Marcou.
Terebratula hastata Sowerby.
Retzia radialis Phillips.
Athyris subtilita Hall.
Spirifer cameratus Morton.

Spiriferina cristata Schlotheim.
Fistulipora nodulifera Meek.
Rhombopora lepidendroides Meek.
Septopora biserialis Swallow.
Aviculopecten coxanus Meek and Worthen.
A. germanus Miller and Faber.
Lima retifera Shumard.
Macrodon carbonarius Cox.
M. tenuistriatus Meek and Worthen.
M. obsoletus Meek.
Astartella vera Hall.
A. newberryi Meek.
Edmondia nebrascensis Geinitz.
Pleurotomaria tenuicincta Meek and Worthen.
P. conf. *speciosa* Geinitz.
Orthoceras cribrosum Geinitz.
Phillipsia cliftonensis Shumard.
Calamites sp.

A fauna of probably the same age has been described from the upper part of the Wyoming Valley limestones of the Upper Productive Coal Measures of Pennsylvania.*

Fayetteville Shale.

In Scott county, 2 N., 29 W., section 36, near the centre, C E. Siebenthal and J. F. Newsom discovered a bed of brown thinly laminated shale, with some sandy layers, containing pyritiferous nodules in which *Goniatites* (*Glyphioceras*) conf. *sphæricus* Martin was found in a good state of preservation. In the shale itself were found many poorly preserved specimens of the *Goniatites* conf. *sphæricus*, and countless specimens of *Posidonomya* (*Lunulicardium*) conf. *fragosum* Meek, also many specimens of *Orthoceras* sp.

These were at first thought to belong to the Coal Measures, but a very similar bed of shale, with the same fossils in the identical state of preservation, were found at Moorefield, Independence county, in the Fayetteville shale, which probably corresponds to the Warsaw group of the Lower Carboniferous.

COMPARISON WITH THE PERMO-CARBONIFEROUS OF KANSAS AND NEBRASKA.

It will readily be seen that the fauna of the Upper Coal Measures of Arkansas bears a strong resemblance to that of the youngest Paleozoic beds of Nebraska, described as Permian by Prof. Geinitz in his monograph, "Carbonformation and Dyas in Nebraska."

F. B. Meek † redescribes this fauna, and comes to the conclusion that the rocks in question are not to be referred to the Permian, because he can find no paleontologic or stratigraphic break in the series. He finds sixteen genera characteristic of the Carboniferous and seven genera not thought to antedate the Permian in Europe, but associated with genera not thought to occur later than the Carboniferous. Meek[*] says that Fusulina, which occurs in great numbers in the Upper Coal Measures of Nebraska, is considered in Europe to be mainly a Lower Carboniferous genus. In this, however, he was mistaken ; his opinion dates from the time when geologists were inclined to place all Carboniferous limestone in the Lower Carboniferous. But it is now known that Carboniferous limestone occurs in the Upper Carboniferous about as often as in the Lower, and that the Fusulina limestones of Sicily and Russia grade over into beds of undoubted Permian age.

---

* *Penna. Geol. Survey Ann. Rep.*, 1885, pp. 437–458, C. A. Ashburner and A. Heilprin. "Report on the Wyoming Valley Limestone Beds."

† *Final Report U. S. Geol. Survey Nebraska*, p. 128, *et seq.*

This is also true of corresponding beds in the upper part of the Carboniferous of Texas, since the line between Permian and Coal Measures is purely arbitrary.

Although undoubtedly believing in continuity of life and formations, Meek seems to have based his reasoning somewhat upon the old idea of catastrophies, since he thought that the absence of a paleontologic or stratigraphic break was a sufficient reason for calling the beds in question Upper Coal Measures rather than Permian. A large majority of the genera and species are characteristic of the Carboniferous, and this Meek thinks sufficient to offset the fact that several genera previously considered typical of Permian are present. But some of these doubtful strata have at last been acknowledged to be Permian[†] by Williams and Tschernyschew, and Prof. Hyatt has described in the *Fourth Annual Report of the Geological Survey of Texas* several cephalopods that are common to the Permian of Texas and of Kansas.

In the Upper Coal Measures of Arkansas, out of fifty-two species, there are twenty-five in common with the doubtful strata of Nebraska, and eleven other species are common to the Nebraskan Permo-Carboniferous and the Lower Coal Measures of Arkansas, but have not yet been found in the Upper Coal Measures of the latter state. But of the genera mentioned by Meek as being not considered to antedate the Permian of Europe only two are found in the Arkansas strata, namely, *Synocladia*[‡] and *Lima*.

There is not sufficient reason for classing the Poteau mountain beds with the Permian, but their fauna, as well as stratigraphic position, place them very high in the Coal Measures, since they are like the fauna and position of the Mississippi Valley Upper Coal Measures.

These beds derive an additional interest from the fact that on Poteau mountain, 1000 feet of shale, in which no fossils were sought for, lie above the thin layer from which the entire collection was taken; thus the chances of finding true Permian beds in that region are very good.

---

[*] P. 133, *op. cit.*

[†] *Trans. Kansas Acad. Sci.*, Vol. xiii, p. 38.

[‡] Waagen has shown in *Pal. Indica, Salt Range Fossils* i, *Productus Limestone Fossils*, p. 802, that *Synocladia* is not found in America, the species described by Swallow as *Synocladia biserialis* being a *Septopora*. There is also some doubt as to whether *Lima retifera* is a true *Lima*.

RELATIONS TO THE TEXAS UPPER CARBONIFEROUS.

The most philosophical presentation of the Permian problem in America has been given by Dr. C. A. White.* He finds the fauna of the upper Paleozoic beds of northern Texas, discovered by Prof. W. F. Cummins, to be analogous to that of the Fusulina Limestone of Sicily, the Artinsk stage of Russia, and the upper Productus Limestone of the Salt Range in India. These strata all show that peculiar commingling of ordinary Coal Measure fossils with ammonite genera, such as *Popanoceras*, *Medlicottia* and *Waagenoceras*, which seems to be characteristic of open sea facies of the Permian.

None of the characteristic ammonite genera were found in the Arkansas region, but nearly every fossil found in these Coal Measures was also found in Texas. And in the Texas Permian nearly all the species excepting the ammonites were found in the underlying Upper Coal Measures. This makes the analogy between the Upper Coal Measures of the two regions very strong.

Nearly all these fossils are also found in Illinois, Iowa, etc., in beds that have never been thought to be other than Coal Measures.

We are, therefore, safe in concluding that while some of the beds in western Arkansas are very high up in the Coal Measures, none that belong above them are as yet certainly known, and the Poteau mountain syncline, across the line in Indian Territory, is the only place where there is any likelihood of finding Permian deposits. These beds may turn out to be the equivalents of the Wichita division of the Texas Permian, which, as Prof. W. F. Cummins has told the writer, contains the exact fauna of his Albany division. The Albany beds were formerly thought to be Coal Measures; and Prof. Cummins' work in determining them by paleontology as well as stratigraphy to be the equivalents of the Wichita division will be of great help in the study of the doubtful so-called uppermost Coal Measure strata all over the Mississippi Valley. Many of these strata are very probably the homotaxial equivalents of the Albany division, and of the Artinsk stage of the Ural mountain region.

COMPARISON WITH FOREIGN UPPER CARBONIFEROUS.

The Lo-ping Fauna of China.

The descriptions of the fauna of this Lo-ping district of China by Prof. E. Kayser† throw great light on the relations of American Carboniferous faunas to those of Asia. Near Lo-ping, in eastern China, are found in beds overlying the coal beds numerous marine fossils of Upper Coal Measure age. Kayser has described fifty-five species, ten not specifically identified, fifteen cosmopolitan species, and eleven forms that are typically American, and belong chiefly to the Upper Coal Measures.

---

* Bulletin 77, *U. S. Geol. Survey*.

† Richtofen's *China*, Vol. iv.

Macrocheilus anguliferus.
Schizodus wheeleri.
Macrodon carbonarius.
Aviculopecten maccoyi.
Retzia compressa.
Orthis pecosii.
Productus mexicanus.
Rhombopora lepidendroides.
Lophophyllum proliferum.
Lophophyllum proliferum var. *sauridens.*
Fusulina cylindrica var. *gracilis.*

Also the *Nautilus orientalis* Kayser is most closely related to *N. occidentalis* Swallow, and *Nautilus mingshanensis* Kayser resembles the same American species. *Myalina trapezoidalis* Kayser finds its nearest representative in *M. subquadrata* Shumard. The fifteen cosmopolitan species are also nearly all found in the American Upper Coal Measures, so that of the entire Lo-ping fauna nearly all the species are either found in America, or they have their nearest relatives there. The two regions belong to the same zoölogical province, the Pacific Carboniferous sea.

Many of these species that are very common in America and Asia are unknown or rare in Europe, which fact would tend to prove a connection with Asia by water, and the separation of the European and the American Upper Coal Measure deposits by a land barrier.

The Carboniferous plants collected by Baron von Richthofen numbered about forty species, and are nearly all identical with European Carboniferous plants. The natural inference is that in those times Asia was connected by land with Europe, while the sea opened out to the east.

Prof. J. S. Newberry * described a small collection of Carboniferous plants from China, and found nearly all of them to belong to well-known European species. This is in perfect agreement with the conclusions drawn above.

The Salt Range Beds of India

In the Salt Range, in northwest India, are found Upper Carboniferous deposits, some of which resemble those of Lo-ping, China, and the Lower Productus Limestone of India is probably of the same age as the beds of Lo-ping, and the western American Uppermost Coal Measures. These deposits and their fauna are described by Prof. W.

---

* *American Journal of Science*, Vol. cxxvi, 1883, p. 123 *et seq.*

Waagen, in the *Paleontologia Indica*, and in the volume on *Geological Results* he draws some very interesting parallels between the faunas of the Upper Carboniferous in different countries. Many of the American species that are found at Lo ping are also found in the Salt Range beds. This same type of Carboniferous is found on Sumatra, where it has been described by Ferd. Roemer,* and on Timor, where it was described by E. Beyrich.†

This is the furthest southward that the Indian or northern type of Upper Carboniferous is known, and indeed the deposits of Sumatra and Timor begin to show already a greater affinity for the Australian or southern deposits.

Waagen‡ divides the Carboniferous into two types—the northern, or Asiatic, and the southern, or Australo-African. The northern type is found in western Europe, Russia, the Himalayas, China, the Arctic regions, and North America. The southern type is developed in South Africa and Australia, and extends into Peninsular India and Afghanistan. Brazil probably belongs to this type, but is to a certain extent transitional.

The Itaitúba Fauna, Brazil.

A comparison of the Brazilian Upper Carboniferous fauna, as described by Prof. O. A. Derby,§ shows that of twenty-seven species of Brachiopoda twelve are identical with American forms, although most of these are cosmopolitan. The genus *Strophalosia* is common in these beds, and as Prof. Derby‖ says, the species shows affinity with the Permian. Many of the new species are closely related to European forms. Prof. W. Waagen,¶ says that the beds of Itaitúba are of the same age as the Middle Productus Limestone of India, that is of the Permo-Carboniferous transition beds. The Brazilian *Strophalosia* is closely related to Australian forms, indicating a closer connection with the Australian or southern Carboniferous region than with the Pacific province.

CLASSIFICATION AND AGE OF THE ARKANSAS COAL MEASURES.**

Provisional Classification.

The Coal Measures of Arkansas have been temporarily classified by the Survey, for the sake of convenience, as Upper or Productive, and Lower or Barren Coal Measures. The division is not based on any paleontologic or stratigraphic break, but merely on the occurrence or non-occurrence of coal.

---

* *Palæontographica*, Vol. xxvii, 1880.

† *Abhandlungen der Berliner Akademie der Wissenschaften*, 1865.

‡ *Salt Range Fossils, Geological Results*, p. 239.

§ *Bulletin Cornell University*, Vol. i, No. 2, and *Journal Geol.*, Vol. ii, pp. 480–501.

‖ *loc. cit.*, p. 60.

¶ *Salt Range Fossils, Geological Results*, p. 207.

** The writer is greatly indebted to Messrs. E. T. Dumble and W. F. Cummins of the Geological Survey of Texas, for their kindness and courtesy to him in the Texas Museum, also for valuable aid in the correlation of the Coal Measures of Arkansas and Texas.

The divisions that are recognized in Pennsylvania could not be recognized in Arkansas, but the strata of the two sections are correlated as far as possible, with the scanty data now at hand.

The Lower Coal Measures.

Of the age of the Lower Coal Measures we have only stratigraphic evidence, their position above the limestones of the Lower Carboniferous and below the coal-bearing beds of the Upper Coal Measures being unmistakable. But their known fauna and flora have been too limited and indecisive to enable us to correlate the stages with those of other Carboniferous areas, since collections have been made in but few places, and these chiefly in sandstones, where the preservation of fossils is usually unsatisfactory, and the determination uncertain.

But the Lower Coal Measures correspond in a general way to the Strawn and the lower part of the Canyon division of Texas, to the Pottsville Conglomerate series, the Lower Productive Coal Measures, and part of the Lower Barren Coal Measures of Pennsylvania. The series corresponds in the main to the Middle Carboniferous limestone of eastern Russia.

The Upper Coal Measures.

The Arkansas Upper Coal Measures correspond to the upper part of the Canyon and the whole of the Cisco division of Texas,* and below the transitional Permo-Carboniferous or Artinsk stage, to which latter age the lower part of the Wichita and Albany divisions of Texas belong. The Lower Permo-Carboniferous beds of Kansas and Nebraska are also probably to be correlated with the Artinsk† stage, although Waagen‡ classes the entire series with the ammonite-bearing beds of northern Texas, described by Dr. C. A. White, in Bulletin 77 of the U. S. Geological Survey. Most of the latter Texas beds belong rather above the Artinsk stage, and in the true Permian, and are probably of the same age as the *Middle* and *Upper Productus Limestone* of the Salt Range.

Waagen, in *Salt Range Fossils, Geological Results*, p. 238, gives a comparative table, showing the relationship of the upper Paleozoic strata all over the world. While the position assigned some of the American deposits does not agree with that accepted by most American geologists, still the table is very useful for comparison, and it has been freely used in compiling the comparative table accompanying this paper.

---

* The writer, in *Journal Geology*, Vol. ii, p. 194, following Karpinsky, placed the *Popanoceras parkeri* beds in the lower Permian or Artinsk, but in this he was mistaken. Prof. W. F. Cummins told the writer that these beds are not in the Upper Cisco, but in the Strawn division, and therefore are Lower Coal Measures.

† Karpinsky, *Ammoneen der Artinsk-Stufe*, p. 92.

‡ *Salt Range Fossils, Geological Results*, p. 204.

The beds of Poteau mountain, Indian Territory, are probably of the age of the Lo-ping strata, while the yellow shales of Scott county, Arkansas, 1 N., 28 W., section 4, southeast quarter of southeast quarter, are probably of the age of the Upper Carboniferous Limestone of Moscow, and the west slope of the Urals,[*] if we can judge by the occurrence of *Gastrioceras* conf. *marianum* and *Pronorites* in them. This would make them older than the Poteau mountain shales, which is very likely the case. They are the probable equivalents of the Canyon division of Texas.

Paleobotanic Evidence.

Our knowledge of the paleobotany of the Coal Measures of Arkansas has been up to the present time very limited, depending almost entirely on the publications of Lesquereux in the *Second Annual Report of a Geological Reconnoissance of the Middle and Southern Counties of Arkansas*, 1860, and in the *Second Geological Survey of Pennsylvania*, "Report of Progress, P. Description of the Coal Flora of the Carboniferous Formation in Pennsylvania, and throughout the United States," 1884.

The joint monograph[†] of H. L. Fairchild and David White on the *Fossil Flora of the Coal Measures of Arkansas* throws much new light on the stratigraphic and regional distribution of species, and has been of material aid in correlating the Arkansas strata with those of other regions. They prove that all the Coal Measure plants[‡] published from Arkansas belong to the horizon of the Upper or Productive Coal Measures. The Van Buren plant bed is thought from paleobotanic evidence to belong above the horizon from which most of the coal of Arkansas is obtained, that of the Ouita coal, and this agrees with the evidence given by the stratigraphy and the marine fossils. The Van Buren plant bed occurs below the Poteau mountain marine beds, and above those in 8 N., 32 W., section 12, Sebastian county, near Fort Smith; and these latter marine beds occur above the horizon of the Ouita coal.

The Poteau mountain marine beds are of about the same age as the Wyoming Valley limestones[§] of the Upper Productive Coal Measures of Pennsylvania, and these belong below the Dunkard creek series of the Upper Barren Coal Measures. The Dunkard creek beds have lately been proved by Prof. I. C. White[‖] to be of the same age as the Permian of northern Texas, on the basis of plant remains that occur towards the top of the Texas beds in which marine Permian fossils were found.[¶]

But the paleobotanic evidence aids in establishing the age of the

---

[*] C2 of Tschernischew, *Mém. Com. Géol. Russie*, Vol. iii, No. 4, p. 353.

[†] An unpublished report of the Geol. Survey of Arkansas.

[‡] The work of the Survey shows that the plants described by Lesquereux from Washington county as Subconglomerate belong to the Lower Carboniferous.

[§] Upper part of C2, Tschernischew, *Mém. Com. Géol. Russie*, Vol. iii, No. 4, p. 353.

[‖] *Bull. Geol. Soc. America*, Vol. iii, p. 217.

[¶] Bull. 77, *U. S. Geol. Survey*.

Upper Coal Measures only; plants are not reported on from any horizons of the Lower Coal Measures, although they are known from a few localities.

Owen[*] mentions *Stigmaria ficoides* as occurring at Patterson's mill, near Bee Rock, on Little Red river, White county. In August, 1892, a few plants were found by the Survey in the Bee Rock sandstone near the base of the series and below most of the marine fossils, but none of these could be identified.

Mr. D. McRae, of Searcy, informed the Survey that in 7 N., 7 W., section 4, White county, were found shales containing numerous *Lepidodendra* and ferns. These shales are above the Bee Rock sandstones.

In a well at Dr. Griffin's, 5 N., 10 W., section 5, near El Paso, White county, specimens of *Lepidodendron* were collected by Dr. J. C. Branner, in micaceous flaggy sandstone, thought to be of about the same age as the shales of Searcy. About fifty feet above the flaggy sandstone was found a thin bed of coal, and thirty feet higher was another coal bed with numerous ferns and *Calamites*.

C. S. Prosser[†] mentions plants supposed to be of Lower Carboniferous age, from Shinall mountain, in 2 N., 14 W., section 17; also from section 20 of the same township.

In quarries in the sandstones of Big Rock, near the city of Little Rock, are found plant remains of indeterminable character. The stratigraphy of the Survey places the three last localities in the Lower Coal Measures, and probably above the fossiliferous sandstones of Bee Rock, on Little Red river.

The Pacific Carboniferous Sea.

Revolution in Devonian Time.

In Paleozoic times there have been many revolutions and alternations of continents and seas, and consequent readjustment of their inhabitants to new surroundings. One of the greatest of these revolutions was that which broke up a large zoölogical province, and put in direct connection regions that before were separated.

Dr. A. Ulrich[‡] has shown that in Lower and Middle Devonian the faunas of Bolivia, Brazil, the Falkland Islands and South Africa were very similar to those of North America, and that they were very different from the faunas of Europe and Asia. This state lasted until the end of the Middle Devonian, when the revolution began. Prof. H. S. Williams[§] has shown that with the beginning of the Upper Devonian in America there came in a fauna, many species of which were not the direct descendants of those immediately preceding them. This new fauna was, however, closely related to forms known in Europe and Asia, but unlike those of the southern regions. Prof. Williams[*] afterwards elaborated this theory and followed out closely the changes that were inaugurated towards the close of the Devonian. The culmination of these changes produced the Pacific[†] Carboniferous sea.

---

[*] *Second Geol. Reconn. Ark.*, Vol. i, p. 68.

[†] *Ark. Geol. Survey Ann. Rep.*, Vol. iii, 1890, p. 423.

[‡] *Beiträge zur Geologie und Paläont. Südamerika, I,* "Paläozoische Versteinerungen aus Bolivien."

[§] *Bull. Geol. Soc. Amer.*, Vol. i, "The Cuboides Zone and Its Fauna."

The Carboniferous Sea.

From Chapter v, in Suess' *Antlitz der Erde*, Vol. ii, we get many valuable suggestions as to the outlines of the Pacific Carboniferous ocean. The Subcarboniferous was the time of greatest transgression of sea over the present land areas, while the sea in which the *Fusulina* beds of Europe and America were formed was more circumscribed.

The Waverly group when traced towards the west gradually takes on the character of deep water formations; it is persistent through Nevada and California,[‡] and has been shown by the writer[§] to have a similar fauna in these two states. The Waverly probably persisted much longer in the west than in the east, for in northern Missouri Dr. C. R. Keyes[‖] has observed that in the midst of an undoubted Burlington fauna a well-marked Kinderhook or Waverly fauna reappears. This he explains by Barrande's theory of colonies. It is probably an incursion of the inhabitants of a deeper western sea, where the Waverly had persisted longer, into the shallower eastern waters. The work of the Geological Survey of Arkansas shows that a similar phenomenon occurs in that state. The Fayetteville shale, which is of Warsaw or St. Louis age, contains a fauna that differs markedly from those of the limestones above and below it. A recent paper by Prof. Henry S. Williams[¶] shows the occurrence in the Fayetteville shale of several species that occur in a doubtful Upper Devonian or Lower Carboniferous black shale in the White Pine district, Nevada. Along with these Devonian or Waverly species occur others that belong much higher, as *Productus semireticulatus* and *Goniatites* conf. *sphæricus*. Below the Fayetteville shale is the Boone chert, which at the base contains a decided Burlington fauna, and at the top probably belongs to the Warsaw. This has been observed in so many places that there is no possibility of mistake in the sequence of the strata.

We have therefore in Arkansas an incursion similar to that in Missouri, except that in Arkansas the incursion came considerably later. This is evidence that somewhere in the west the Waverly fauna persisted throughout the Osage and possibly a part of the St. Louis. This is in accordance with the phenomenon described by Prof. C. D. Walcott in Monograph viii, U. S. Geological Survey, from the Eureka district, Nevada, where a Waverly fauna occurs three thousand feet above the base of the Carboniferous formation. The same thing has been observed by the writer in the Carboniferous of Shasta county, California.*

---

[*] *Proc. Amer. Assoc. Adv. Sci.*, 1892, Section E, Address, "The Scope of Paleontology and Its Value to Geologists."

[†] See also Tschernischew, *Mém. Com. Géol. Russie*, Vol. iii, No. 4, p. 364, on the physical geographic changes that occurred in Europe towards the end of the Carboniferous.

[‡] Zoe, Vol. iii, p. 274, *Proc. Calif. Acad. Sci.*, Oct. 17, 1892.

[§] *Journ. Geol.*, Vol. ii, No. 6, Metamorphic Series of Shasta County, California.

[‖] *American Journal of Science*, December, 1892, p. 447.

[¶] *Amer. Journal of Science*, Vol. xlix, 1895, pp. 94–101.

The Lower Carboniferous limestones can be traced all through the West and the Mississippi valley, to the base of the Appalachian mountains, where they are replaced by conglomerates and other coarse sediments.

Upper Carboniferous in the West.

Of the Upper Carboniferous all that we know west of Indian Territory takes on a decidedly marine character, containing thick beds of limestones. There are however some thin beds of coal in Texas, and some carbonaceous seams with a few land plants in New Mexico and Nevada. The coal in Texas was probably deposited near the southern shore line of the Carboniferous sea, and the carbonaceous seams in the far West probably belong to the insular areas. The fossils described from the western Carboniferous are all marine, with the slight exception that Walcott† mentions a few specimens of pulmonate Gasteropoda that were found along with brachiopods, corals and land plants, evidently washed in from a distance, since no terrestrial Carboniferous deposits are known near the Eureka district.

The Pawhuski Limestone.

In the the eastern part of Indian Territory are found large deposits of coal in the Upper Coal Measures, but further west the same horizon is represented by marine limestone. In 1892, Mr. H. C. Hoover, of the Geological Survey of Arkansas, found at the Government lime-kiln, three miles northwest of Pawhuski, Oklahoma Territory, Osage agency, a bed of massive limestone about 100 feet thick, lying horizontally on heavily bedded sandstones. The limestone is fossiliferous, but the sandstones are not. The fossils collected were placed at my disposal, and on examination they proved to be;

Spirifer cameratus Morton.
Athyris subtilita Hall sp.
Productus semireticulatus Martin, sp.
Productus nebrascensis Owen.
Productus splendens Norwood and Pratten.
Derbyia crassa Meek and Hayden.

These are plainly of Upper Carboniferous age. The limestones cap the hills in that region, and spread over a great area, but fossils were collected at this place only.

---

* *Journal of Geology*, Vol. ii, No. 6, pp. 588-612.

† *Mon. viii. U. S. Geol. Survey*, p. 262.

Interchange of Life Between East and West.

The many beds of marine fossils in the Productive Coal Measures are simply transgressions from the western sea, and reach no further east than Pennsylvania and West Virginia. The Appalachian system was the western border of the ancient Atlantis[*] which separated the European from the Pacific waters, while the great Indo-Australian[†] continent bounded the Pacific ocean on the south. This ocean must have stretched from the American Coal Measures to Eastern China, the Salt range in India, the Ural mountains on the borders of Russia, and into the Arctic regions, for we find related faunas in all these places. Whatever we have of western European Coal Measure species must have migrated from this direction, since on the east there was no direct communication with European waters. An example of this is *Productus giganteus*[‡] Martin, which is common in Europe, and is found in the Lower Carboniferous of the McCloud river, Shasta county, but is not found east of that place, unless *P. latissimus* Sowerby, from Montana, west of the main chain of the Rocky mountains, be an equivalent. Another example is *Omphalotrochus whitneyi* Meek, which was first described from the Carboniferous limestone of Shasta county, California, but is also very common in the Lower Coal Measure limestone (C2) of eastern Russia.[§]

On the other hand, many species seem to be confined to, or characteristic of, this ocean; among them may be mentioned *Productus cora* d'Orbigny, which Waagen[‖] says is not found in Europe, its nearest representative being *Productus riparius* Trautschold; it was however first described from South America.

Goniatites marianus Verneul is found in the Artinsk region of the Urals and in Arkansas. The genus *Pronorites*, while found in western Europe, is rare in it, and is much more common in the Pacific region. *Pronorites* is found in the Artinsk region and in Arkansas, while the ammonite genus *Medlicottia*, the direct descendant of *Pronorites*, is found in the Permo-Carboniferous strata of Sicily, the Urals, the Salt range, and Texas.

It is impossible to suppose that the same genus and species originated at different localities, and since we have both ancestors and descendants in places so widely separated, we can only suppose that there was free interchange of life between those places at that time, or in other words an open sea, on the borders of which these fossiliferous deposits were laid down, and along the margin of which the cephalopods and other marine animals could migrate.

---

[*] Suess, *Antlitz der Erde*, ii, p. 17.

[†] Suess, *Ibid.*, ii, p. 316.

[‡] See *Annual Report U. S. Geog. and Geol. Surv. Terr.*, 1883, Part i, p. 132, and *Bull. Geog. and Geol. Surv. Terr.*, Vol. ii, No. 4, p. 354.

[§] See *Journal Geol.*, Vol. ii, No. 6, pp. 598–600.

[‖] *Pal. Indica*, Salt Range Fossils, Brachiopoda, p. 677.

Replacement of Limestones by Coal-bearing Formations in Western Europe.

On tracing the Upper Carboniferous deposits of the Ural region towards the west, we find the limestones thinning out, and the Coal measures and Culm formations taking their places; we find also that the transgression of marine on terrestrial deposits takes place from the east, just the reverse of what is seen in America.

Land Areas in the West.

It is not thought that the Pacific Carboniferous sea was an unbroken expanse of water in western America; on the contrary there are many evidences of large isolated land areas and archipelagos. Dr. Joseph Le Conte* has argued that the Basin range, during much of Paleozoic and Mesozoic time, was a continent, off the western shores of which the sediments that afterwards became the Sierra Nevada and Coast range were laid down. Clarence King† thought that the great thickness of Paleozoic littoral deposits in the Great Basin region proved the existence of a large body of land further west; he thought that the eastern shore of this continent was in Nevada, and east of this stretched the Carboniferous sea, which covered all but the island chain of the Rocky Mountain region. King‡ further concluded that the Carboniferous in California, west of the old shore line, indicated shallow bays that permitted the western extension of the upper Paleozoic deposits, while the bulk of them was stopped by the bold coast. There are evidences of land areas in the Rocky mountains, Wahsatch mountains, New Mexico, and Nevada, but from the facts now known it seems more probable that these were large islands or archipelagos, rather than continents.

THE PERMIAN PACIFIC OCEAN.

The outlines of the great western ocean can be traced in Permian times also, but with much more circumscribed limits. Open-sea deposits of this age are known in Texas, in the Salt range, on the west slope of the Urals, on the island of Sicily, and in scattering places in Central Asia. In all these the genera are nearly the same, except that the *Arcestes* types are confined to the more southern regions. This similarity indicates plainly a connection of these deposits.

Suess§ argues that the open-sea Permian fauna wandered in from the south, and that the Mesozoic types of ammonites were foreign to the northern regions. Karpinsky,‖ on the contrary, holds that they were autochthonous, at least in the Ural region, since he could trace the descent of all the ammonites except the *Popanocerata* from goniatites that were found in the underlying Carboniferous. As has been already mentioned, the ammonite genus *Medlicottia* is not a foreigner on this side of the Permian Pacific ocean, because its ancestor, *Pronorites*, is found here too.

---

* *American Journal of Science*, iii, Vol. 16, p. 108.

† *U. S. Geol. Explor. Fortieth Parallel*, Vol. i, p. 534.

‡ *Op. cit.*, p. 535.

§ *Antlitz der Erde*, ii, p. 316.

‖ *Ammoneen der Artinsk-Stufe*, p. 86.

THE TRIASSIC PACIFIC OCEAN.

Our knowledge of the Triassic Pacific ocean is based on the work of Mojsisovics, *Arktische Triasfaunen*.[*] We find that in this period the American part of the great western ocean has mostly become land, and only on the western border of America do we find marine Triassic beds, in Nevada, California, Idaho, and along the coast region in widely separated places, from Alaska through British America to Peru.

These deposits, with similar faunas, can be traced on the other side of the Pacific from New Zealand, Timor, New Caledonia, to Japan, and Siberia. This sea stretched out on one side over the Himalayas to the eastern Alps, forming what Neumayr[†] called the "central Mediterranean sea." On the other side the sea stretched up to Spitzbergen, but did not reach the Atlantic region. The Triassic was a continental period for the greater part of the present continents.[‡] After the Trias the outlines of the western ocean had changed entirely, and no resemblance to the original boundaries can be traced.

TIME OF THE OUACHITA UPLIFT.

The youngest rocks known to take part in the Ouachita Mountain system belong to the Upper Coal Measures, and the disturbance must have taken place at the border between Carboniferous and Permian. Still, it is not unlikely that deposits of Permo-Carboniferous age may yet be found at some places in the region.

Another fact that makes this time for the uplift probable is that the Permo-Carboniferous beds of Kansas and Nebraska are not of the open-sea type, but belong to the northern European or Zechstein type of deposits. The beds of Texas, presumably of nearly the same age, are of the Artinsk or open-sea facies, and are characterized by the occurrence of ammonites, commingled with ordinary Upper Coal Measure fossils.

This uplift may be of the same age as that movement in the Appalachians[§] which cut off the Upper Barren Coal Measures of Pennsylvania and West Virginia[‖] entirely from the western sea; in those deposits no marine fossils are found, but only land plants and fresh-water Crustaceans,[¶] and a few fresh-water mollusks.

---

[*] *Mem. Acad. Imper. Sci. St. Petersbourg*, Tome 33, No. 6.

[†] *Denkschrift Wiener Akad.*, 1885, "Die geographische Verbreitung der Juraformation."

[‡] Suess, *Antlitz der Erde*, ii, p. 147.

[§] *Penna. Second Geol. Survey*, P. P., p. 120.

[‖] I. C. White, *Bull. 65th U. S. Geol. Survey*, p. 41.

[¶] *Penna. Second Geol. Survey*, P. P., Permian Flora, W. M. Fontaine and I. C. White, p. 116.

CORRELATION TABLE OF THE COAL MEASURES OF ARKANSAS.

		ARKANSAS.	INDIAN TERRITORY	TEXAS.	MISSISSIPPI VALLEY	PENNSYLVANIA	CHINA AND OTHER PARTS OF ASIA	RUSSIA AND URAL MTS.	INDIA	SOUTH AMERICA
PERMIAN			Permo-Carboniferous	Permian Wichita and Albany Series	Permo-Carbonifer's of Kansas & Nebraska	Upper Barren Coal Measures	Bokhara Cephalopod Beds	Kostroma Permian Artinsk Stage	Productus Limestones	Itaitúba Beds
COAL MEASURES OR PENNSYLVANIAN	UPPER COAL MEASURES	Poteau Mountain Marine Beds. . . . Van Buren Plant Beds. . . . . Fort Smith Marine Beds. . . . . . . Ouita Coal Horizon with Plants . . . Boles, Scott County, Beds with *Goniatites marianus* and *Pronorites*. . . .	Productive Coal Measures Pawhuski Limestone	Cisco Canyon	Upper Coal Measures	Upp. Prod. Coal Meas. Lower Barren Coal Meas. Wyoming Valley Limestones	Marine Beds of Lo-ping Productive Coal Measures of China	North. Russia Nova Zembla Upper Carboniferous Limestone	Split Limestones	Plant Beds
	LOWER COAL MEASURES	Morrillton Marine Beds . . . . Conway County Millstone Grit, with Marine Fossils. . . . . Big Rock, Pulaski County, Plant Beds El Paso, White County, Plant Beds . Searcy, Bee Rock, Marine Beds . . . Searcy, Bee Rock, Plant Beds		Strawn	Lower Coal Measures	Lower Prod. Coal Meas. Pottsville Conglomerate		Middle Carboniferous Limestone	Muth Quartzites Limestones	
LOWER CARBONIFEROUS OR MISSISSIPPIAN.		Lower Carboniferous Limestone . . .	Lower Carboniferous Limestone	Bend Division	Lower Carboniferous Limestone	Mauch Chunk Series	Lower Carboniferous Limestone	Lower Carboniferous Limestone	Crinoidal	

DESCRIPTIONS OF THE COAL MEASURE MARINE FOSSILS.

The lists of fossils given above establish beyond question the age of the species described in this paper, and enable us, even without the aid of stratigraphy, to assign them to their proper horizon, by a study of the accompanying faunas. Of the goniatites only one, *Gastrioceras branneri* J. P. S., is thought to be a new species, although all are new to Arkansas. *Gastrioceras marianum* Verneul, and *Pronorites cyclolobus* Phillips, have never before been found outside of Europe; *Gastrioceras globulosum* Meek and Worthen is found here for the first time outside of Illinois; *Gastrioceras excelsum* Meek is found for the first time outside of Kansas; *Paralegoceras iowense* Meek and Worthen is found here for the third time, being known elsewhere only in Iowa and in Texas, and shows on the Arkansas specimen the internal lobes, features that have never before been seen in this species and genus.

Both stocks or families are represented in the collection, and genera that probably were the ancestors of important genera and families in the Permian and the Mesozoic, and thus as transitional forms, or links in genetic series, they command especial interest. All species described in this paper are deposited in the geological museum at Stanford University, except the originals of *Gastrioceras branneri* J. P. S., and *Pronorites cyclolobus* Phillips, var. *arkansiensis* J. P. S., which are deposited in the U. S. National Museum.

Subkingdom COELENTERATA.

Class *Anthozoa*.

Genus **FISTULIPORA**, McCoy. ***Fistulipora nodulifera*** Meek, *U. S. Geol. Survey Nebraska*, p. 143, Pl. v, Fig. 5.

This species, which is common in the Upper Coal Measures of Nebraska, Iowa, Illinois, etc., was found in corresponding strata on Poteau mountain, Indian Territory.

Genus **LOPHOPHYLLUM**, Milne-Edwards and Haime. ***Lophophyllum proliferum*** McChesney sp., McChesney, *Descript. New Pal. Foss.*, 1860, p. 75; F. B. Meek, *U. S. Geol. Survey Nebraska*, p. 144.

Several specimens agreeing with the typical *L. proliferum* were found in the Upper Coal Measures of Poteau mountain, Indian Territory. Specimens closely resembling this species were also found in the Boone Chert, Lower Carboniferous, of Boone county, 17 N., 19 W., section 2, near Valley Springs. The latter specimens are more like *Lophophyllum proliferum* var. *sauridens* White, C. A. White, *U. S. Geog. Surv. W. of 100th Meridian*, iv, p. 101, Pl. vi, Fig. 4, from Carboniferous strata, New Mexico and Colorado.

Genus **ZAPHRENTIS**, Rafinesque. *Zaphrentis*, sp. indet.

In Crawford county, 10 N., 30 W., section 10, southeast quarter of northwest quarter, in strata of the Lower Coal Measures, and in the same formation in Conway county, 5 N., 16 W., section 17, near centre of the north half, were found specimens of this genus, too poorly preserved to allow the species to be determined.

Subkingdom ECHINODERMATA.

Class *Crinoidea.*

Genus CYATHOCRINUS, Miller.

In the Upper Coal Measures of Poteau mountain, Indian Territory were found a great many stems that seem to belong to *Cyathocrinus,* but no other parts were found, to make the identification more certain.

Genus ERISOCRINUS, Meek and Worthen. *Erisocrinus* (*Ceriocrinus*) *inflexus* Geinitz, sp. *Cyathocrinus inflexus* Geinitz, *Carbonformation und Dyas in Nebraska,* p. 62. *Poteriocrinus hemisphæricus* Shumard, *Trans. St. Louis Acad. Sci.*, i, p. 221. *Scaphiocrinus hemisphæricus* Shumard, sp., F. B. Meek, *U. S. Geol. Survey Nebraska,* p. 147. *Erisocrinus* (*Ceriocrinus*) *inflexus* Geinitz, sp., C. A. White, *Twelfth Ann. Rept. Hayden's U. S. Geol. Survey Wyoming and Idaho,* Part i, p. 128, Pl. xxxiv, Fig. 9.

This species which is common in the Coal Measures of Nebraska, Utah, etc., was found in the Upper Coal Measures of Poteau mountain, Indian Territory.

Genus HYDREINOCRINUS, De Koninck. *Hydreinocrinus mucrospinosus* McChesney, sp. *Zeacrinus mucrospinosus* McChesney, *Descr. New Pal. Foss.*, p. 10. *Hydreinocrinus mucrospinosus* McChesney, F. B. Meek, *U. S. Geol. Survey Nebraska,* p. 149.*

Found in the Upper Coal Measures of Poteau mountain, Indian Territory.

Genus POTERIOCRINUS, Miller. *Poteriocrinus,* sp. indet.

In the Upper Coal Measures of Poteau mountain, Indian Territory, were found numerous crinoid stems that seem to belong to Poteriocrinus.

Crinoidea, genus undetermined.

In the Lower Coal Measures of White county, 8 N., 7 W., section 33, southeast quarter, and section 26, southeast quarter, and in beds of the same age in Pope county, Point mountain spur, 10 N., 20 W., section 8, southeast quarter of northwest quarter, were found numerous crinoid stems, which could not be identified since they were mostly in the form of moulds or casts.

---

* Meek cites this species from Arkansas, but gives no locality, or authority for the statement.

Subkingdom MOLLUSCOIDEA.

Class *Bryozoa.*

Genus **FENESTELLA**, Lonsdale. *Fenestella shumardi* Prout., *Trans. St. Louis Ac. Sc.*, i, p. 232; F. B. Meek, *U. S. Geol. Survey Nebraska*, p. 153, Pl. vii, Fig. 3.

This species was found in the Upper Coal Measures of Poteau mountain, Indian Territory, and one very closely resembling it, if not identical, was found in the Boone Chert, Lower Carboniferous, at several places in northwestern Arkansas.

Genus **RHOMBOPORA**, Meek. *Rhombopora lepidendroides*, F. B. Meek, *U. S. Geol. Survey Nebraska*, p. 141, Pl. vii, Fig. 2; C. A. White, *U. S. Geol. Survey W. of 100th Meridian*, iv, p. 99, Pl. vi, Fig. 5.

This Bryozoan is common and characteristic in the Upper Coal Measures of Nebraska, and is found in the same horizon in Utah and Arizona, and was also found in the Upper Coal Measures of Poteau mountain, Indian Territory. The same, or a very similar species, occurs in the Boone Chert, Lower Carboniferous, of northern Arkansas.

Genus **SEPTOPORA**, Prout. *Septopora biserialis* Swallow, sp. *Synocladia biserialis* Swallow, *Trans. St. Louis Ac. Sci.*, i, p. 179; F. B. Meek, *U. S. Geol. Survey Nebraska*, p. 156, Pl. vii, Fig. 5; C. A. White, *Survey W. of 100th Meridian*, iv, p. 107, Pl. vii, Fig. 3.

This species is common in the Upper Coal Measures, or Permo-Carboniferous, of Nebraska and Kansas, and in the true Coal Measures of Illinois, and in the Upper Carboniferous of Arizona. It has also been found in the Chester and the St. Louis Limestone, Lower Carboniferous, of Illinois. Waagen* says that the true genus *Synocladia* has not been found in America, and that in Europe or Asia it is characteristic of the Permian. He refers the American forms to the genus *Septopora* of Prout.

Class *Brachiopoda.*

Genus **ORTHIS**, Dalman. *Orthis pecosii* Marcou, *Geol. North Amer.*, p. 48. *O. carbonaria* Swallow, *Trans. St. Louis Ac. Sci.*, i, p. 218. *O. carbonaria* Meek, *U. S. Geol. Survey Nebr.*, p. 173. *O. pecosii* Marcou, C. A. White, *U. S. Geol. Survey W. of 100th Merid.*, iv, p. 125, Pl. ix, Fig. 5. *Orthis*, sp. indet., Meek, *Pal. Cal.*, i, p. 10, Pl. ii, Fig. 5, a, b, c.

A single specimen was found in the Upper Coal Measures of Poteau mountain, Indian Territory; it agrees best with Dr. C. A. White's figures. The species is of frequent occurrence in the Upper Coal Measures of Iowa, Nebraska, Kansas, Illinois, Texas and in the Upper

---

* *Pal. Indica*, Salt Range Fossils, I. Productus Limestone Fossils, p. 802.

Carboniferous of New Mexico, and in the Lower Carboniferous of California. Dr. C. A. White * mentions a small Orthis, similar to this species, from the Keokuk of Iowa and Illinois. In the Boone Chert, Lower Carboniferous, of northern Arkansas, probably Keokuk, was also noticed a small Orthis of this type, but the preservation was not good enough for the identification to be certain.

Orthis conf. *resupinoides* Cox, *Geol. Surv. Kentucky*, Vol. iii, p. 570, Pl. ix, Fig. 1 ; C. A. White, *U. S. Geog. Survey West of 100th Merid.*, Vol. iii, Appendix, p. 23, Pl. iii, Fig. 2.

This type of Orthis is exceedingly rare in the Carboniferous, being rather characteristic of the Devonian. *O. resupinoides* is found in the Coal Measures of Kentucky and the Upper Carboniferous of New Mexico. Dr. C. A. White compares the species to *Orthis iowensis* Hall, *O. tulliensis* Vanuxem and *O. propinqua* Hall of the Devonian.

A few poorly preserved specimens were found in White county, 8 N , 7 W., section 33, southeast quarter, east half, in the Lower Coal Measures ; also in Conway county, 8 N., 17 W., section 33, northeast quarter of northeast quarter.

Genus DERBYIA, Waagen. *Derbyia crassa* Meek and Hayden. *Orthisina crassa* M. and H., *Proc Ac. Nat. Sci. Phil.*, 1858, p. 260. *Streptorhynchus crassus* M. and H., F. B. Meek, *U. S. Geol. Surv. Nebraska*, p. 174. *Derbyia crassa* M. and H., Waagan, *Salt Range Fossils, Brachiopoda*, p. 592.

This species is widely distributed in the Coal Measures of Kansas, Nebraska, Illinois, Texas, etc., and was found in the Upper Coal Measures of Poteau mountain, Indian Territory, and in the Lower Coal Measures of Conway county, Arkansas, 6 N., 16 W., section 29, southwest quarter of southwest quarter. It is also very common in the Lower Carboniferous of the Mississippi valley.

Genus PRODUCTUS, Sowerby. *Productus cora* d'Orbigny, *Paleont. de l'Amer. Merid.*, 1842, p. 48. *P. cora* d'Orbigny, C. A. White, *Geol. Survey Indiana*, 1883, p. 126, Pl. xxvi, Fig. 1, 2, 3, =*P. pratterianus* Norwood.

This species is almost world-wide in its distribution in the Coal Measures, and is also found in the Productus Limestone of the Salt Range, India. Waagen, in *Paleontologia Indica, Salt Range Fossils, Brachiopoda*, p. 677, says that the true *Productus cora* is probably not found in Europe, its nearest representative being *P. riparius* Trautschold.

In America the typical species is very common in both Coal Measures and Lower Carboniferous. It was found in the former horizon on Poteau mountain, Indian Territory, and in the latter in numerous places ; Fayetteville shale, probably Warsaw, Independence county, 13

---

* *U. S. Geog. Survey W. of 100th Merid.*, iv, p. 126.

N., 6 W., section 18, southeast quarter of southeast quarter, near Moorefield; Marshall shale, probably Warsaw division, Independence county, 12 N, 6 W., section 12, and Stone county, Blue mountain, 14 N., 11 W.; Archimedes Limestone, probably of St. Louis age, Independence county, 12 N., 6 W., section 14.

Marcy (*Expl. Red River of Louisiana*, p. 187) cites this species from Subcarboniferous limestone of Washington and Crawford counties, but does not give the localities.

Productus (Marginifera) splendens Norwood and Pratten. *Productus splendens* Norwood and Pratten, *Jour. Acad. Nat. Sci. Phil.*, 1854, Vol. iii, p. 11, Pl. i, Fig. 5. *P. wabashensis* Norwood and Pratten, *Jour. Acad. Nat. Sci. Phil.*, 1854, p. 13, Pl. i, Fig. 6. *P. longispinus* Meek (non Sowerby), *Final Report U. S. Geol. Survey Nebraska*, p. 161. *Marginifera splendens* N. and P., Waagen, *Palæontologia Indica, Salt Range Fossils, Productus Limestone Fossils, Brachiopoda*, p. 714.

This typical Upper Coal Measure and Permian species is a probable descendant of *Productus longispinus* Sowerby, and so closely are these two related, that for many years they were considered identical. But the *Marginifera* type of Productus seems to be confined to the Upper Carboniferous and Permian, while *P. longispinus* Sowerby is also found in the Lower Carboniferous. The Arkansas specimens agree perfectly with specimens from Indiana and Illinois. This species is very common in the Coal Measures and Permian of North America, and probably occurs also in Asia. A very similar small species occurs in the Lower Carboniferous limestone, Stone county, 14 N., 11 W., on Blue mountain, but this lacks the ventral sinus, and has fewer spines, and therefore probably belongs to the true *P. longispinus* Sowerby.

P. (Marginifera) splendens N. and P. was found in the Upper Coal Measures of Sebastian county, Arkansas, 8 N., 32 W., section 12, and on Poteau mountain, Indian Territory, in strata that are either of uppermost Coal Measure or of Lower Permian age.

Productus punctatus Martin. *Anomites punctatus* Martin, *Petrif. Derb.*, Pl. 37, Fig. 6. *Productus punctatus* Martin, Davidson, *Mon. Brit. Carb. Brachiopods*, p. 172.

This species is cosmopolitan in the Coal Measures and Lower Carboniferous, although more common in the latter horizon. It is very seldom that the shell is so preserved that the internal characteristics can be seen. In the figured specimen the arm impressions, adductor muscle scars, median septum, and the cardinal process are all perfectly preserved.

The dorsal valve is somewhat squarer than those figured by Davidson (*Mon. Brit. Carb. Brach.*, Pl. 44, Figs. 9–17), but the internal markings are the same in every detail, except that Davidson's figure makes the cardinal process a little longer. The internal characteristics are imperfectly illustrated by McChesney (*Trans. Chicago Acad. Sci.*, Pl. i, Figs. 10, 11).

Occurrence.—Productus punctatus was found in great numbers in the upper part of the Lower Coal Measures of Conway county, 6 N., 16 W., section 29, on the east bank of Arkansas river, about one mile below the Old Lewisburg ferry. It was also found in the Lower Carboniferous at several places in the State.

Productus semireticulatus Martin, sp., *Petrifacta Derbiensia*, p. 7.

This well-known cosmopolitan species was found in the Barren or Lower Coal Measures in White county, 8 N., 7 W., section · 33, southeast quarter, and in section 26, southeast quarter. It was also found in the Lower Carboniferous, in the Fayetteville shale, probably Warsaw, in Searcy county, 16 N., 17 W., section 1, southwest quarter of southwest quarter; in the Boone Chert, upper Burlington or lower Keokuk, in Searcy county, 17 N., 18 W., section 28, and at various other places in northern Arkansas; in the Marshall shale, probably Warsaw, in Stone county, on Blue mountain, 14 N., 11 W., south of Mountain View.

Genus RHYNCHONELLA, Fischer de Waldheim. *Rhynchonella uta* Marcou. *Terebratula uta* Marcou, *Geol. of N. Amer.*, p. 58. *Rhynchonella osagensis* Swallow, *Trans. St. L. Ac. Sci.*, 1858, p. 219. *Rhynchonella osagensis*, F. B. Meek, *U. S. Geol. Surv. Nebraska*, p. 179. *Rhynchonella uta* Marcou, C. A. White, *U. S. Geol. Expl. W. of 100th Merid.*, iv, p. 128.

This characteristic Coal Measure species, found in Kansas, Nebraska, Iowa, Missouri, Illinois, Texas and South America (?), was found in the Upper Coal Measures of Sebastian county, 8 N., 32 W., section 12; also in the same horizon on the Poteau mountain, Indian Territory.

Rhynchonella, sp. indet.

In the Lower Coal Measures of White county, 8 N., 7 W., section 33, southeast quarter, and of Crawford county, 10 N., 30 W., section 10, southeast quarter of northwest quarter, were found several Rhynchonellas that could not be specifically determined.

Genus TEREBRATULA Lhwyd. *Terebratula hastata* Sowerby, *Mineral Conchology*, Vol. v, p. 446. *Terebratula bovidens* Morton, *Am. Journ. Sc*, Vol. xxix, p. 150. *Terebratula bovidens*, F. B. Meek, *U. S. Geol. Surv. Nebraska*, p. 187, Pl. i, Fig. 7.

Meek (*loc. cit.*) speaks of the strong resemblance of *T. bovidens* to *T. elongata* Schlotheim, sp., and *T. hastata* Sowerby, sp., but is strongly inclined to believe in the specific difference. Davidson (*Monograph Brit. Carb. Brach.*, Appendix, p. 226) is inclined to unite *T. elongata*, *T. hastata* and *T. sufflata*. If *Dielasma bovidens* is really identical with *T.*

hastata, it is an example of one species ranging from the Devonian up into the Permian. This species ranges through the Coal Measures in Nebraska, Kansas, Illinois, Texas, New Mexico, etc. It is very common in the Upper Coal Measures of Poteau mountain, Indian Territory, and was also found in the Fayetteville shale, Lower Carboniferous, probably Warsaw, of Independence county, 13 N., 6 W., section 13, southeast corner, near Moorefield; also in the Lower Coal Measures of Conway county, 8 N., 17 W., section 33, northeast quarter of northeast quarter.

Genus ATHYRIS, McCoy. *Athyris subtilita* Hall. *Terebratula subtilita* Hall, *Stansbury's Expl. Gt. Salt Lake*, p. 409. *Athyris subtilita* Hall, sp., F. B. Meek, *U. S. Geol. Surv. Nebraska*, p, 180, Pl. i, Fig. 12, Pl. viii, Fig. 4.

This species is found nearly all over the world in the Coal Measures. It is also found in various places in the Lower Carboniferous, as in England and India

It was found to occur frequently in the Upper Coal Measures of Sebastian county, 8 N., 32 W., section 12, and of Poteau mountain, Indian Territory; in the Boone Chert, Burlington or lower Keokuk, of Stone county, 14 N., 10 W., section 9, northwest quarter.

Marcy (*Expl. Red River of Louisiana*, p. 189) cites *Athyris subtilita* from the Subcarboniferous limestone of Washington county.

Genus RETZIA, King. *Retzia radialis* Phillips. *Terrebratula mormonii* Marcou, *Geol. N. Amer.*, p. 51, Pl. vi, Fig. 1. *Retzia punctilifera* Shumard, *Trans. St. Louis Ac. Sci.*, i, p. 220. *Retzia subglobosa* McChesney, *New Pal. Foss.*, p. 45, Pl. i, Fig. 1. *Retzia compressa* Meek, *Pal. Calif.*, i, p 14, Pl. ii. Fig. 7.

R. radialis is common in the Western Coal Measures and Lower Carboniferous; it was found in great numbers in the Upper Coal Measures of Sebastian county, 8 N., 32 W., section 12, and of Poteau mountain, Indian Territory.

Genus SPIRIFER, Sowerby. *Spirifer cameratus* Morton, *Am. Journ. Sc.*, Vol. xxix, p. 150. *Spirifer meusibachianus* Rœmer, *Kreidebildung von Texas*, p. 88. *Spirifer triplicatus* Hall, *Stansbury's Expl. Gt. Salt Lake*, p. 410. *Spirifer cameratus* Morton, C. A. White, *U. S. Expl. W. of 100th Merid.*, iv, p. 132, Pl. x, Fig. 1.

This species is distributed throughout the Coal Measures from Pennsylvania and West Virginia to Arizona; it is also found in the Permo-Carboniferous of Kansas;* Meek, in *Geol. Expl. 40 Parallel*, iv, p. 8, cites the species from the Upper Carboniferous of the White Pine Mining district of Nevada. It was found in great numbers in the Upper Coal Measures of Sebastian county, 8 N., 32 W., section 12, and of Poteau mountain, Indian Territory; also in the Lower Coal Measures of Conway county, 6 N., 16 W., section 29, southwest quarter of southwest quarter.

---

* F. B. Meek, *U. S. Geol. Surv. Nebraska*, p. 184.

Spirifer rockymontanus Marcou, *Geol. of N. Amer.*, p. 50, Pl. vii, Fig. 4. *Spirifer opima* Hall, *Geol. Surv. Iowa*, Vol. i, Part ii, p. 711. *Spirifer subventricosa* McChesney, *Desc. New Pal. Foss.*, p. 44. *Spirifer rockymontanus* Marcou, C. A. White, *U. S. G. Expl. W. of 100th Merid.*, iv, p. 134, Pl. xi, Fig. 9.

S. rockymontanus occurs in the Upper Carboniferous from Pennsylvania to New Mexico.

It was found in the Lower Coal Measures of White county, 8 N., 7 W., section 33, southeast quarter, in the form of well-preserved casts, also in section 26, on Bee Rock; also in the same horizon, Crawford county, 12 N., 30 W., section 17. These specimens agree with Dr. White's figures and descriptions so well that no further description is necessary.

Genus SPIRIFERINA, d'Orbigny. *Spiriferina cristata* Schlotheim. *Terebratulites cristatus* Schlotheim, *Beiträge Nat. Verst. Muenchen*, Pl. i, Fig. 3. *Spiriferina kentuckensis* Shumard, *Geol. Surv. Missouri*, 1858, p. 203. *Spirifer octoplicatus* Hall, *Stansbury's Expl. Gt. Salt Lake*, p. 409, Pl. xi, Fig. 4. *Spirifer laminosus* Geinitz, *Carbonformation und Dyas in Nebraska*, p. 45, Pl. iii, Fig. 11. *Spiriferina kentuckensis* Shumard, sp., F. B. Meek, *U. S. Geol. Surv. Nebraska*, p. 185, Pl. vi, Fig. 3, Pl. viii, Fig. 11.

Dr. C. A. White, in *U. S. Geog. Expl. W. of 100th Merid.*, iv, p. 140, egards *S. octoplicatus* Hall and *S. kentuckensis* Shumard as distinct species. C. D. Walcott, *Pal. Eureka District*, p. 218, regards them both, as well as *S. spinosa* Norwood and Pratten, as synonyms of *S. cristata* Schlotheim, sp. If this reference is correct, then the species ranges from the Upper Devonian of the White Pine Mining district into the Upper Carboniferous of the Eureka district.

Davidson (*Monograph Brit. Carb. Brach.*, p. 267) regards *Spiriferina octoplicata* Sowerby, sp., as synonymous with *S. cristata* Schlotheim, sp., which ranges from the Carboniferous into the Permian. Taken in these broader limitations, the species ranges from the Devonian, through the Lower Carboniferous of the West, and through the entire Coal Measures from Kentucky to Nevada.

Hall (*Geol. Survey Iowa*, Vol. i, Part ii, p. 706, Pl. xxvii, Fig. 5) describes and figures *Spiriferina spinosa* N. and P. from the Kaskaskia group of Iowa. He states that *S. spinosa* differs from *S. kentuckensis* in being more robust and in possessing the tubular spines.

But specimens of *S. kentuckensis* from the Upper Coal Measures of Arkansas are equally robust and possess the spines that are thought to be characteristic of *S. spinosa*.

A comparison of specimens from the Upper Coal Measures of Sebastian county, 8 N., 32 W., section 12, shows the perfect resemblance between the two so-called species. There are five distinct but rather rounded plications on each side of the mesial fold and sinus, but no concentric striations or lamellæ were observed. The entire surface is thickly covered with short spines, which seem to be unusually well preserved.

This species was found in the Lower Coal Measures of Conway county, 6 N., 16 W., section 29, southwest quarter of southwest quarter, and in the Upper Coal Measures at the locality mentioned in Sebastian county; also on Poteau mountain, Indian Territory; in the Lower Carboniferous, Boone Chert, upper Burlington or lower Keokuk, at St. Joe, in Searcy county.

Subkingdom MOLLUSCA.

Class *Lamellibranchiata.*

Genus AVICULOPECTEN, McCoy. *Aviculopecten carboniferus* Stevens, *Amer. Journ. Sc.*, Vol. xxv, p. 261.

Two imperfect specimens from the Lower Coal Measures, White county, 8 N., 7 W., section 26, southeast quarter, agree fairly well with the figures and descriptions of this species. Another specimen was found in the Lower Coal Measures of Conway county, 5 N., 16 W., section 17, northwest quarter.

Aviculopecten coxanus Meek and Worthen, *Proc. Acad. Nat. Sc. Phil.*, 1860, p. 453; *Geol. Surv. Ill.*, ii, p. 326, Pl. xxvi, Fig. 6; F. B. Meek, *U. S. Geol. Surv. Nebraska*, p. 196, Pl. ix, Fig. 2.

This species is found in the Upper Coal Measures of Illinois and Nebraska, and was also found in the same horizon on Poteau mountain, Indian Territory.

Aviculopecten germanus Miller and Faber, *Journ. Cin. Soc. Nat. Hist.*, July, 1892, p. 79.

This species was described from the Coal Measures of Elkhorn creek, Kentucky, and was compared by the authors to *A. rectilaterarius* Cox sp., *Geol Surv. Kentucky*, iii, p. 571, Pl. ix, Fig. 2, but it resembles more closely *A. edwardsi* Worthen, *Bull. 2 State Mus. Nat. Hist. of Ill.*, p. 22; both species were founded on left valves, the right being unknown. They are both very similar to *A. segregatus* McCoy, *British Pal. Fossils*, p. 489, Pl. iii, E, Fig. 1, of the Carboniferous limestone of Northumberland, although the latter has from two to three secondary intermediate ribs, instead of one.

A single small left valve was found in the Upper Coal Measures of Poteau mountain, Indian Territory. It agrees in the main points with Miller and Faber's description, except that the intermediate rib is sometimes obsolete, and distinct concentric lines of growth are seen on the shell.

The beak is sharp, and projects beyond the cardinal margin : the ribs number about twelve, and are rather coarser than those shown in Miller and Faber's figures.

Aviculopecten occidentalis Shumard, *Geol Survey Missouri,* 1855, Part ii, p. 207, Pl. C, Fig. 18.

This species is very common in the Coal Measures from Pennsylvania to Arizona ; in Arkansas it was found in the Lower Coal Measures of Conway county, 5 N., 16 W., section 17, northwest quarter ; about four miles southeast of Morrillton, and 6 N., 16 W., section 29, east bank of Arkansas river, about one mile below the Old Lewisburg ferry, in the Lower Coal Measures.

Genus LIMA. *Lima retifera* Shumard. *Lima retifera* Shumard, *Trans. St. Louis Ac. Sc.*, i, p, 214. *Crenipecten retiferus* Shumard, sp., S. A. Miller, *N. Amer. Geol. and Pal.*, 1889, p. 473.

Lima retifera is characteristic of the Coal Measures in Kansas, Illinois, Nebraska, Texas, etc., and was also found in the Upper Coal Measures of Poteau mountain, Indian Territory.

Genus MACRODON, Lycett. *Macrodon carbonarius* Cox, sp. *Arca carbonaria* Cox, *Geol. Surv. Kentucky,* iii, p. 567, Pl. viii, Fig. 5. *Macrodon carbonarius* Cox sp., F. B. Meek, *Pal. Ohio,* ii, p. 334.

This species resembles so closely *M. obsoletus* Meek, *Pal. Ohio,* ii, p. 334, Pl. xix, Fig. 9, as to raise doubts as to their being different species. They are both found in the Coal Measures, in the upper part of which several specimens of *M. carbonarius* were found on Poteau mountain, Indian Territory. This species was also found in the Lower Coal Measures of Conway county, Ark., 5 N., 16. W., section 17, northwest quarter.

Macrodon obsoletus Meek, *Pal. Ohio,* ii, p. 334, Pl. xix, Fig. 2.

This species, which is found in the Coal Measures of West Virginia and Ohio, also occurs in the Upper Coal Measures of Sebastian county, 8 N., 32 W., section 12, and on Poteau mountain, Indian Territory.

Macrodon tenuistriatus Meek and Worthen, *Proc. Chicago Ac. Sc.*, i, p. 17. *Arca striata* Geinitz, *Carb. u. Dyas in Nebraska,* p. 20, Pl. i, Fig. 32. *Macrodon tenuistriatus* M. and W., F. B. Meek, *U. S. Geol. Surv. Nebraska,* p. 207, Pl. x, Fig. 20.

This is a characteristic Upper Coal Measure species, being found in that horizon in Nebraska, Illinois and Iowa ; it is quite common in the Upper Coal Measures of Poteau mountain, Indian Territory.

Macrodon sp.

In the Upper Coal Measures of Crawford county, 10 N., 30 W., section 10, southeast quarter of northwest quarter, were found specimens of *Macrodon* too poorly preserved to be identified with any species.

Genus NUCULA, Lamarck. *Nucula parva* McChesney, *Proc. Chicago Ac. Sc*, i, p. 39, Pl. ii, Fig. 8. *Nucula parva* McChesney, Meek and Worthen, *Geol. Surv. Illinois*, v, p. 589.

This diminutive *Nucula*, which is found in the Coal Measures of Illinois, was found in the form of casts in ferruginous shale of the Lower Coal Measures of Conway county, 5 N., 16 W., section 17, centre of the north half, and in similar strata of the Upper Coal Measures in Crawford county, 10 N., 30 W., section 10, northwest quarter.

Nucula ventricosa Hall, *Geol. Survey Iowa*, Vol. i, Part ii, p. 716, Pl. 29, Figs. 4 and 5.

This species is common in both Lower and Upper Coal Measures from Pennsylvania to Texas. In Arkansas it was found in the Lower Coal Measures in Conway county, 5 N., 16 W., section 17, northwest quarter, about four miles southeast of Morrillton.

Genus NUCULANA, Link. *Nuculana* aff. *bellistriata* Stevens.

This specimen, found in the form of a mould, showing very distinctly the hinge teeth and the surface markings, resembles in general form *Nuculana bellistriata* Stevens, *Am. Journ. Sc.*, 1858, Vol. xxv, p. 261, but differs from it in having the concentric ribs much coarser and less numerous.

Locality, Scott county, 1 N., 28 W., section 4, southeast quarter of southeast quarter, in the Upper Coal Measures.

Genus SCHIZODUS, King. *Schizodus cuneatus* Meek, Pl. xxii, Fig. 3. *Schizodus cuneatus* Meek, *Pal. Ohio*, Vol. ii, p. 336, Pl. xx, Fig. 7.

An internal cast from the Upper Coal Measures of Crawford county, 10 N., 30 W., section 10, southeast quarter of northwest quarter, agrees in shape with the species described by Meek from the Lower Coal Measures of Ohio. The strongly elevated beak without any backward curve is very characteristic. It being an internal cast, the obscure lines of growth seen on the specimens from Ohio do not show, but the muscle scar is distinct, and indications of the hinge teeth can also be seen. In *Paleontology of Ohio*, Vol, ii, p. 337, Meek mentions a similar *Schizodus* from the Upper Coal Measures of Nebraska, but thinks it is probably a distinct species, on account of the small size, more nearly central beaks and more prominent central and anterior margins. The specimen from Arkansas really agrees better with this description than it does with the undoubted *Schizodus cuneatus*, but the Nebraska specimen was never figured and named. *Schizodus cuneatus* was also found in the Lower Coal Measures of Conway county, 8 N., 17 W., section 33, northeast quarter of northeast quarter.

Schizodus wheeleri Swallow, Pl. xxii, Fig. 4. *Cypricardia* (?) *wheeleri* Swallow, *Trans. St. Louis Acad. Sci.*, Vol. i, p. 96. *Schizodus wheeleri* Swallow, F. B. Meek, *Final Rept. U. S. Geol. Survey Nebraska*, p. 209.

This species is very common in the Coal Measures from Pennsylvania to New Mexico, in both Upper and Lower Coal Measures. It has been figured and described so often that nothing new can be added. Our specimens agree best with those from Iowa, described by F. B. Meek, *Final Report of the U. S. Geological Survey Nebraska*, p. 209, Pl. x, Fig. 1, c.

Occurrence.—Several specimens, both right and left valves, were found in the Lower Coal Measures of Conway county, 8 N., 17 W., section 33, northeast quarter of northeast quarter, at Cook's stone quarry, near Hattieville. This horizon is in the so-called Millstone Grit, and near the middle of the Lower Coal Measures. All the fossils in these strata are preserved in the form of casts.

Schizodus conf. *amplus* Meek and Worthen, *Proc. Ac. Nat. Sci. Phil.*, 1870, p. 41; *Geol. Survey Illinois*, Vol. v, p. 579, Pl. xxvii, Fig. 6.

This large *Schizodus* is found in the Coal Measures of Pennsylvania and Illinois, and an imperfect specimen, probably belonging to the same species, was found in the Lower Coal Measures of White county, 8 N., 7 W., section 33, east half of the southeast quarter, in ferruginous sandstone, on the road from Searcy to Griffin Springs.

Genus ASTARTELLA, Hall. *Astartella newberryi* Meek, *Pal. Ohio*, ii, p. 340, Pl. xix, Fig. 1.

This characteristic species is common in the Upper Coal Measures of Poteau mountain, Indian Territory, and in the Lower Coal Measures of Conway county, Arkansas, 8 N., 17 W., section 33, northeast quarter of northeast quarter.

Astartella vera Hall, *Geol. Survey Iowa*, i, Part ii, p. 715, Pl. xxix, Fig. 1.

This species occurs in the Coal Measures of Iowa, Indiana, Illinois and Pennsylvania, and was found in the upper division of the same series on Poteau mountain, Indian Territory.

Genus PLEUROPHORUS, King. *Pleurophorus oblongus* Meek, *U. S. Geol. Surv. Nebraska*, p. 212, Pl. x, Fig. 4.

This was described by Meek from the Upper Coal Measures of Nebraska, and was found in the Lower Coal Measures of Conway county, 5 N., 16 W., section 17, centre of the north half.

Pleurophorus, sp., C. A. White, *Bull. 77 U. S. Geol. Survey*, p. 27, Pl. iv, Figs. 5–10.

This *Pleurophorus* was described and figured but not named by Dr.

C. A. White (*loc. cit.*), from the Permian of Texas. No analogous form was found in the true Coal Measures of Texas, which is not at all surprising, since their fauna is so little known. In the Upper Carboniferous* beds of Scott county, Arkansas, 1 N., 28 W., section 4, northeast quarter of southeast quarter, was found a single specimen that agrees perfectly with the *Pleurophorus* of Dr. White. It is nothing unusual to find a Permian species in the Carboniferous, but the identification is uncertain, owing to the poor preservation of Dr. White's original and of the Arkansas specimen.

Genus CONOCARDIUM Bronn. *Conocardium aliforme* Sowerby, sp., Pl. xxii, Figs. 1 and 2. *Cardium aliforme* Sowerby, *Min. Conch.*, Vol. vi, p. 100, Table 552, Fig. 2. *Conocardium aliforme* Sowerby, sp., Bronn, *Leth. Geogn.*, i, p. 420, Pl. iii, Fig. 9. *Pleurorhynchus minax* Phillips, *Geol. of Yorkshire*, p. 210, Pl. v, Fig. 27.

This genus is rare in the American Carboniferous, and especially so in the Coal Measures, being represented there by only two other species, *C. obliquum* Meek and Worthen, *Geol. Surv. Illinois*, Vol. vi, p. 529, and *C. parrishi* Worthen, *Geol. Surv. Illinois*, Vol. viii, p. 112. The former is more nearly related to *C. aliforme*, but differs from it in its much smaller size, greater obliquity of the shell, and shorter hinge line. The surface of *C. oliquum* is marked by narrow radiating ribs, while those of *C. aliforme* are wider than the depressions between them.

The intermediate spaces are occupied by a secondary rib only on the rounded anterior side of *C. aliforme*, while the same thing occurs even on the posterior side of *C. obliquum*. *C. aliforme* also has the hinge line longer, and the space between the incurved beaks wider; also the ribs on the anterior cordate space are much finer, and this area is bounded by a rather distinct carina, being slightly concave near the rounded border, and rising toward the anterior rostrum, which is preserved on some of our specimens. The shell has its greatest convexity at the anterior end, where the broad carina cuts off the cordate area. Behind this is a distinct furrow, which shades off into the posterior compression of the shell, and dies out in a gentle curve toward the rounded gaping margin. The ribs are broader and the concentric growth lines more distinct towards the posterior end. The concentric lines are not visible on the cordate area. The posterior portion of the shell, next to the hinge line, is not ribbed, but marked with fine, radial lines.

Goldfuss, in *Petrifacta Germaniæ*, Part ii, p. 203, Pl. cxlii, Fig. 1, describes and figures *Conocardium aliforme*, but according to McCoy† he has confused two species, one of which is a Devonian species from the Eifel. The true *C. aliforme* is that described by Phillips, *Geol. of Yorkshire*, Vol. ii, p. 210, Pl. v, Fig. 2, as *Pleurorhynchus minax*, of the Carboniferous Limestone, and by Goldfuss, Pl. cxlii, Fig. 1, *e*, *f*, *h*, *i*, *l*, and *m*, the others under Fig. 1 belonging to the Devonian species, which McCoy proposes should retain the name *C. hystericum* Schlotheim. Phillips* proposed to transfer the name *C. aliforme* to the Devonian species, but the type originally described by Sowerby under that name is undoubtedly the Carboniferous species.

---

* By the stratigraphy these beds are Barren Coal Measures, but the fossils show close relations to the Upper Coal Measures.

† *British Palæozoic Fossils*, p. 517.

This species is found all over Europe, in the Carboniferous, chiefly Mountain Limestone, but owing to the confusion that exists on the Continent one cannot usually tell whether this means Upper or Lower Carboniferous or both.

Nine specimens were found in the Lower Coal Measures of Conway county, 5 N., 16 W., section 17, centre of the north half. They were found in a ferruginous shale, and although in the form of casts they show the sculpture of the surface with unusual clearness, even the delicate, wavy growth lines being as sharply defined as on the original shell. The specimens all had a length of more than one inch, the dimensions of the largest being : length, 1.30 inch ; diameter, 0.88 inch ; width of the cordate area, 0.62 inch.

Genus EDMONDIA de Koninck. *Edmondia nebrascensis* Geinitz, Meek, *U. S. Geol. Survey Nebraska*, p. 214, Pl. x, Fig. 8. *Astarte nebrascensis* Geinitz, *Carbon. und Dyas in Nebraska*, p. 16, Pl. i, Fig. 25.

A few poorly preserved specimens from the Upper Coal Measures of Poteau mountain, Indian Territory, seem to belong to Meek's Nebraska species.

Edmondia unioniformis Phillips, *Geol. Yorkshire*, Vol. ii, p. 209. *Edmondia unioniformis* (?) Meek and Worthen, *Paleont. Illinois*, Vol. ii, p. 346, Pl. xxvii, Fig. 6.

An imperfect cast from the Upper Coal Measures of Illinois was doubtfully referred by Meek and Worthen to the European species. The Arkansas specimens agree fairly well with Meek's figures and much better with his descriptions, except that they have the concentric ribs coarser.

Occurrence.—Numerous casts were found in the Lower Coal Measures, "Millstone Grit," of Conway county, 8 N., 17 W., section 33, northeast quarter of northeast quarter at Cook's stone quarry.

Class *Glossophora.*

Subclass *Scaphopoda.*

Genus DENTALIUM Linnæus. *Dentalium* conf. *meekianum*, Geinitz, *Carbon. u. Dyas in Nebraska*, p. 13.

This species was described from the Permo-Carboniferous of Nebraska, and was also found in the undoubted Upper Coal Measures of Illinois. Imperfect specimens were also found in the Upper Coal Measures of Crawford county, Arkansas, 10 N., 30 W., section 10, southeast quarter of northwest quarter.

---

* *Pal. Foss. Cornwall, Devon, and West Somerset*, p. 33.

Subclass *Gastropoda*.

Genus **Bellerophon**. *Bellerophon carbonarius* Cox, *Geol. Surv. Kentucky*, Vol. iii, p. 574, Pl. x, Fig. 2. *B. urii* C. R. Keyes, *Proc. Ac. Nat. Sc. Phila.*, July 31, 1888, p. 14.

In the Lower Coal Measures of Conway county, Ark., 5 N., 16 W., section 17, centre of north half, were found specimens of this characteristic Coal Measure species, but poorly preserved. Better ones were found in the Lower Coal Measures of Conway county, 6 N., 16 W., section 29, southwest quarter of southwest quarter.

Bellerophon crassus Meek and Worthen, *Geol. Surv. Illinois*, ii, p. 385, Pl. xxxi, Fig. 16.

This species is found in the Upper and Lower Coal Measures of Indiana, in the Subcarboniferous and the Coal Measures of Pennsylvania, and the Upper Carboniferous limestone of Nevada, etc. Good specimens of it were found in the Lower Coal Measures of Conway county, Ark., 5 N., 16 W., section 17, centre of the north half.

Bellerophon marcouanus Geinitz, *Carbon. u. Dyas in Nebraska*, p. 7.

This species in the Upper Coal Measures of Kansas, Nebraska and Iowa, in the Coal Measures of Illinois and West Virginia, and was found in the Upper Coal Measures of Sebastian county, Ark., in 8 N., 32 W., section 12.

Bellerophon sp.

In the Lower Coal Measures of White county, 8 N., 7 W., section 33, southeast quarter, and section 26, southeast quarter in the massive sandstone, were found several large imperfect specimens of a *Bellerophon* that resembles *B. crassus*, but it is probably a different species; it is too imperfectly known for specific identification and description.

Genus **Pleurotomaria**, Defrance. *Pleurotomaria modesta* Keyes, *Proc. Ac. Nat. Sc. Phila.*, 1888, p. 238, Pl. xii, Fig. 2. *P. depressa* Cox, *Geol. Surv. Kentucky*, iii, p. 569, Pl. viii, Fig. 10.

A single specimen of this exceedingly delicate and beautiful species, showing all the markings, was found in the Upper Coal Measures of Crawford county, Ark., 10 N., 30 W., section 10, southeast quarter.

Pleurotomaria conf. *speciosa* Meek and Worthen, *Proc. Ac. Nat. Sci. Phila.*, 1860, p. 459; *Geol. Surv. Illinois*, Vol. ii, p. 352, Pl. xxviii, Fig. 5.

One small imperfect specimen from the Upper Coal Measures of Poteau mountain, Indian Territory, shows the characters of the Illinois species, although very much smaller. The well-defined suture and fine ornamentations are similar on both and serve to make their identity probable.

Pleurotomaria tenuicincta Meek and Worthen, *Proc. Ac. Nat. Sci. Phila.*, 1860, p. 459; *Geol. Surv. Illinois*, Vol. ii, p. 355, Pl. xxviii, Fig. 8.

This species was described from the Upper Coal Measures of Illinois, and a similar specimen was found in the same horizon on Poteau mountain, Indian Territory.

Pleurotomaria harii S. A. Miller, *Seventeenth Annual Report State Geologist of Indiana*, p. 693, Pl. xiv, Figs. 3, 4.

This species was recently described from the Upper Coal Measures of Kansas City, Mo , and until now has not been found anywhere else. It is a very striking form and easily recognized. The rather rounded whorls are about five in number and marked with numerous rather coarse revolving ribs, which show traces even on the cast.

A single cast, and mold showing the surface markings, was found in the Lower Coal Measures, so-called "Millstone Grit," of Conway county, 8 N., 17 W., section 33, northeast quarter of northeast quarter, at Cook's quarry, near Hattieville.

Pleurotomaria sp.

In the Lower Coal Measures of Conway county, 5 N., 16 W., section 17, centre of the north half; in Franklin county, 12 N., 28 W., section 27, southeast quarter of northwest quarter; and in Pope county, on Point mountain, 10 N., 20 W., section 8, southeast quarter of northwest quarter, were found numerous specimens of *Pleurotomaria*, that while they seem to belong to several distinct species could not be more accurately identified. They are all preserved as casts and usually badly weathered.

Genus EUOMPHALUS, Sowerby. *Euomphalus* (*Straparollus*) *subquadratus* Meek and Worthen, *Geol. Surv. Illinois*, Vol. v, p. 605, Pl. xxix, Figs. 12, 13.

This very common species was found in the Lower Coal Measures of White county, Ark., in 9 N., 4 W., section 6, and 9 N., 5 W., section 1, in a soft pinkish sandstone, along with *Phillipsia* (*Griffithides*) *scitula* Meek and Worthen.

Euomphalus (*Straparollus*) sp.

In the Lower Coal Measures of Independence county, Ark., 11 N., 5 W., centre of section 9, was found a specimen of *Euomphalus* that seemed to be different from *E. subquadratus* but could not be determined with certainty.

Genus NATICOPSIS, McCoy. *Naticopsis nana* Meek and Worthen. *Platyostoma nana* Meek and Worthen, *Proc. Ac. Nat. Sc. Phila.*, 1860, p. 463. *Natacopsis nana* Meek and Worthen, *Geol. Surv. Ill.*, ii, p. 365, Pl. xxxi, Fig. 4. *Naticopsis nana* Meek and Worthen, C. A. White, *U. S. Expl. W. of 100th Merid* , iv, p. 159, Pl. xii, Fig. 4.

This characteristic Upper Carboniferous species is distributed from

Illinois to Nevada; it was found in the Upper Coal Measures of Sebastian county, Ark., 8 N., 32 W., section 12, associated with numerous other fossils characteristic of the same horizon.

Naticopsis sp.

In the Upper Coal Measures of Scott county, Ark., 1 N., 28 W., section 4, southeast quarter of southeast quarter, was found a specimen of *Naticopsis* that resembles somewhat *N. shumardi* McChesney, found by Dr. White in the Permian of Texas, Bull. 77, *U. S. Geol. Surv.*, p. 24, Pl. iii, Fig. 11, but it is too imperfect to justify a reference to this species.

Genus **MACROCHEILUS**, Phillips. *Macrocheilus* conf. *fusiformis* Hall, *Geol. Surv. Iowa*, i, Part ii, p. 718, Pl. xxix, Fig. 7.

In the ferruginous shale of the Lower Coal Measures of Conway county, Ark., 5 N., 16 W., section 17, centre of the north half, were found a few specimens that probably belong to Hall's Coal Measure species.

Macrocheilus (*Soleniscus*) *primigenius* Conrad, Hall, *Geol. Surv. Iowa*, Vol. i, Part ii, p. 720, Pl. xxix, Fig. 11.

This species is widely distributed in the Coal Measures of the Mississippi Valley states, and was also found in the Lower Coal Measures, in Conway county, Ark., 5 N., 16 W., section 17, centre of the north half.

Genus **POLYPHEMOPSIS**, Portlock. *Polyphemopsis inornata* Meek and Worthen, sp. *Loxonema inornata* Meek and Worthen, *Proc. Ac. Nat. Sc. Phila.*, 1860, p. 463. *Polyphemopsis inornata* M. and W., *Geol. Surv. Illinois*, ii, p. 374, Pl. xxxi, Fig. 8.

This species, originally described from the Upper Coal Measures of Illinois, was found in the same horizon in Crawford county, Ark., 10 N., 30 W., section 10, southeast quarter of northwest quarter.

Subclass *Pteropoda*.

Genus **CONULARIA**, Miller (Sowerby). *Conularia* conf. *crustula* White, *XII Am. Rep. U. S. Geol.* and *Geog. Surv. of Terr.*, 1878, p. 170, Pl. xlii, Fig. 4; *U. S. Expl. W. of 100th Merid.*, iii, Appendix, p. 28, Pl. iii, Fig. 4.

The genus *Conularia* is not common in the Lower Carboniferous, but is exceedingly rare in the Coal Measures, so much so that Dr. White mentions this species as being the only representative in that series. Dr. White found it in the Coal Measures near Kansas City, and also near Taos, N. M. The species has been found in the Coal Measures of Texas, and also in the Coal Measures of Scott county, Ark., 1 N., 28 W., section 4, southeast quarter of southeast quarter.

Class *Cephalopoda.*

Order *Tetrabranchiata.*

Suborder *Nautiloidea.*

Genus **Endolobus**, Meek and Worthen. *Endolobus* (*Nautilus*) *missouriensis* Swallow, sp., Pl. xxi, Figs. 1–3. *Nautilus missouriensis* Swallow, *Trans. St. Louis Ac. Sc.*, 1857, p. 198. *Endolobus missouriensis* Swallow, sp., C. A. White, *Indiana Geol. Survey*, 1883, p. 166, Pl. xxxv, Figs. 1, 2.

This species resembles very closely *Endolobus spectabilis* Meek and Worthen, *Geol. Surv. Illinois*, ii, p. 308, Pl. xxv, Fig. 18, and, as Dr. C. A. White* remarks, almost the only reason for regarding them as distinct species is their occurrence in such different horizons as the Chester Limestone of the Subcarboniferous, and the Coal Measures. Also Dr. White's specimen was poorly preserved, and he thought it might possibly have had the nodes originally. It is really impossible to recognize the species by Swallow's imperfect original description, but Dr. White's description is very useful in determining this species, which in the Coal Measures of Arkansas does not have nodes on the sides of the shell; the difference is all the more probable, because in the Fayetteville shale, Lower Carboniferous, of Independence county, near Moorefield, was found an *Endolobus*, with very strongly marked nodes, resembling, if not identical with, *E. spectabilis*.

This species also resembles *Endolobus* (*Solenocheilus*) *indianensis* Worthen, *Geol. Surv. Illinois*, viii, p. 150, Pl. xxviii, Fig. 1, but on the Arkansas specimens the whorls are more embracing, are broader and not so high.

In *E. gibbosus* Hyatt, *Second An. Rept. Geol. Survey, of Texas*, p. 353, the whorls are much more flattened, and the umbilicus is narrower, and the umbilical shoulder subangular, while in *E. missouriensis* the shoulders are round. In both, as in *E. spectabilis*, in adult specimens the outer whorl embraces nearly one-half of the next inner whorl. The septa are like those of *E. spectabilis*, and are far apart, gently sinuous and deeply concave. The internal lobe is deep and funnel-shaped. The siphon is slightly nearer the internal than the external side, and is slender.

The casts are smooth, but some specimens have the shell partly preserved. It is ornamented with fine, sharp, spiral lines crossed by finer lines of growth, about one-half as far apart as the spiral lines, giving a finely reticulated appearance to the shell; these transverse lines bend sharply backward on the outside of the whorl.

In our collections are septate fragments of specimens that must have been at least four inches in diameter, and the body chamber would have added about one-half of another revolution, so this species attained a diameter of not less than six inches.

---

* *Geol. Surv. Indiana*, 1883, p. 166.

The best preserved specimens are small, being only the inner whorls of large individuals, since the body chamber is not seen on any of them.

Dimensions of a small specimen, figured on Pl. xxi, Fig. 2:

Dimensions.	MM.
Diameter	28
Height of the last whorl from umbilicus	19
Height of the last coil from the top of the inner whorl	11

Position and Locality.—Several specimens of this species were found in the Lower Coal Measures of Conway county, Ark., 5 N., 16 W., section 17, centre of the north half.

Genus EPHIPPIOCERAS, Hyatt. *Ephippioceras ferratum* Cox. *Nautilus ferratus* Cox, *Geol. Surv. Kentucky*, iii, Fig. 574, Pl. x, Fig. 2. *Ephippioceras ferratum* Cox, A. Hyatt, *Proc. Boston Soc. Nat. Hist.*, 1883, p. 290.

A single large specimen that probably belongs to this species was found in the Lower Coal Measures of Conway county, Ark., 5 N., 16 W., section 17, centre of the north half. Owen, in his *Report on a Geol Recon. Arkansas*, Vol. i, p. 68, cites *Nautilus ferratus* from a bold point three (?) miles northwest of Searcy, White county. The rocks of that region are now known to belong to the Lower Coal Measures.

Nautilus sp.

In the Upper Coal Measures of Crawford county, Ark., 10 N., 30 W., section 10, southeast quarter of northeast quarter, were found fragments of a *Nautilus* too imperfect even for reference to any of the genera into which the old genus *Nautilus* has been split up.

Genus ORTHOCERAS, Breynius. *Orthoceras cribrosum* Geinitz, *Carbon. u. Dyas in Nebraska*, p. 4. *Orthoceras cribrosum* Geinitz, Meek, *U. S. Geol. Surv. Nebraska*, p. 234, Pl. xi, Fig. 18.

In the Upper Coal Measures of Poteau mountain, Indian Territory, were found specimens of *Orthoceras*, showing the peculiar indentations of surface supposed to be characteristic of this species. The markings seem to be due to the growth of a bryozoön on the shell, for when magnified they show six-sided cells. Meek, *op. cit.*, p. 234, stated his belief that this marking is accidental.

Orthoceras conf. *rushense* McChesney, *New Pal. Foss.*, p. 68. *Orthoceras rushense*, C. A. White, *Bull. 77, U. S. Geol. Survey*, p. 22, Pl. ii, Figs. 14–16.

This species was described originally from the Coal Measures of Indiana and Illinois, and Dr. C. A. White found it in the Permian of

Texas. Some imperfect specimens that probably belong here were found in the Upper Coal Measures of Scott county, Ark., 1 N., 28 W., section 4, southeast quarter of southeast quarter.

Orthoceras sp.

A long slender form with very close chamber walls could not be identified with any species known from the Carboniferous, but the specimens found were not perfect enough for specific description.

Locality.—This species was found in the Lower Coal Measures of Conway county, 8 N., 17 W., section 33, northeast quarter of northeast quarter, at Cook's quarry, near Hattieville.

Suborder *Ammonoidea.*

The *Cephalopoda* alone, of all animals, preserve in the individual a complete record of their larval and embryonic history, the protoconch and early chambers being enveloped and protected by the later stages of the shell. And by breaking off the outer chambers the naturalist can in effect cause the shell to repeat its life history in inverse order, for each stage of growth represents some extinct ancestral genus. These genera appeared on the scene in the exact order of their minute imitations in the larval history of their descendants, and by a study of adult forms in the order of their appearance the naturalist finds the key to the stages of growth of later forms, and is thus enabled to arrange species and genera in genetic series. Studied in this way, paleontology becomes a biologic science.

It has long been known that the goniatites were the ancestors of the ammonites, and the researches of Branco, Hyatt and Karpinsky have traced out these lines of descent in many cases, by studying the successive genera of adult shells in comparison with stages of growth in the individual. Each ammonite is known to begin its life as a goniatite, and only by gradually increasing complication to reach the ammonitic stage. This advance took place in some stocks much earlier than in others, since some show ammonitic characteristics even in the Carboniferous, while others persist in their goniatitic characteristics even in the Trias. In the great majority of cases, however, the transition was made near the end of Paleozoic time, that is, somewhere during the Carboniferous or Permian.

Classification of Goniatites.—The goniatites have been divided into two great stocks or families, *Goniatitidæ* and *Prolecanitidæ*, both of which persist from the Devonian to the Permian. This classification, while the best at present possible, is by no means satisfactory, for it is certain that some of the forms ascribed to the *Prolecanitidæ* descended from genera classified as *Goniatitidæ*.

The *Goniatitidæ* of the Carboniferous consist of the genera *Branco-*

ceras, Glyphioceras, Gastrioceras, Paralegoceras, Nomismoceras, Pericyclus, Dimorphoceras, with numerous subgenera. They comprise many rough-shelled species, and on this account they are thought by Steinmann[*] to have given rise to the trachyostracan *Ceratitidæ* and *Tropitidæ* of the Trias. In this opinion also concurs Dr. K. A. von Zittel,[†] as far as the *Tropitidæ* are concerned, for these, he thinks, have been developed out of *Gastrioceras* and *Pericyclus*.

The *Prolecanitidæ* of the Carboniferous comprise the genera *Prolecanites, Pronorites. Agathiceras;* all of which live on into the Permian and branch out during that period into a number of genera and subgenera. Some of these genera live on into the Trias, and branch out during that period into numerous families, whose Jurassic and Cretaceous descendants made up the bulk of the cephalopod faunas.

Besides the *Goniatitidæ* and the *Prolecanitidæ* of the Carboniferous, the *Ammonoidea* are represented already in the Coal Measures of America by the families *Arcestidæ*, in *Popanoceras parkeri*[‡] Heilprin, of the Strawn division, Lower Coal Measures of Texas.

In the European Coal Measures the *Tropitidæ* are represented by *Thalassoceras looneyi* Phillips. *Thalassoceras* was described by Gemmellaro[§] to include certain species of the Carboniferous and Permian, and referred to the *Tropitidæ;* this genus, along with *Paraceltites* Gemmellaro, *Gastrioceras*, and some Permian forms referred to *Glyphioceras*, are said by Mojsisovics[‖] to be the Paleozoic representatives of the *Tropitidæ*.

Family *Goniatitidæ* von Buch (Zittel).
Subfamily *Glyphioceratidæ* Hyatt.

This group includes a series of forms that range from the Upper Devonian into the Permian. The older members have the siphonal lobe undivided, thus showing their relationship to the older *Prolecanitidæ*. The form may be compressed and discoidal as in *Brancoceras* of the Devonian and Carboniferous; or broadly rounded and involute, with semilunular cross-section, as in most species of *Glyphioceras;* or evolute, with wide umbilicus, trapezoidal cross-section, and umbilical ribs, as in most species of *Gastrioceras*. The sutures are simple, consisting of a siphonal lobe, which may or may not be divided by a secondary siphonal saddle, and one or two pairs of lateral lobes, which are somewhat pointed, also usually a pair of short lobes on the umbilical shoulders. The internal lobes consist of a long and rather pointed antisiphonal lobe, and a pair of pointed lateral lobes. The saddles, both external and internal are usually rounded, although even they may become angular, as in old specimens of *Glyphioceras sphæricum* Martin. The surface in most of the older members of the group is ornamented only with striæ, but in many, especially the later members, umbilical ribs are developed, which in *Pericyclus* cross the abdomen. Periodic constrictions, or varices, representing temporary cessations of growth, are found on most of the genera.

---

[*] *Elemente der Palæontologie*, 1890, p. 393.

[†] *Grundzüge der Palæontologie*, 1895, p. 405.

[‡] The writer, in *Journ. Geol.*, Vol. ii, No. 2, p. 194. following Karpinsky in *Ammoneen d. Artinsk-Stufe*, p. 92, referred the *Popanoceras parkeri* beds to the Artinsk stage, but Prof. W. F. Cummins, of the Geological Survey of Texas, has pointed out to the writer the true horizon of this species.

[§] *Giornale Sci. Nat. Econom.*, Vol. xix, 1888, p. 67.

[‖] *Das Gebirge um Hallstadt*, Bd. ii, p. 10

Hyatt * says that the *Glyphioceratidæ* are derived directly from the group *Magnosellaridæ*, as represented by *Parodiceras* of the Devonian. And, in fact, the development of *Glyphoceras diadema* Goldfuss, as worked out by Branco,† shows at 2.25 millimetres diameter a decided resemblance to the adult sutures of *Tornoceras*. The younger larval sutures of this form show derivation from a radicle like *Anarcestes*. Pl. xix, Fig. 5, shows the development of *Tornoceras* (*Parodiceras*) *retrorsum* Buch, after Branco, in *Palæontographica*, Vol. xxvii, Pl. v, Fig. 7. We thus have probably the complete genealogy of the *Glyphioceratidæ* in the larval stages of the two genera, *Glyphioceras* and *Tornoceras*. Pl. xix, Fig. 4, shows the development of *Glyphioceras diadema* Goldfuss, after Branco, in *Palæontographica*, Vol. xxvii, Pl. iv, Fig. 1.

Genus GASTRIOCERAS, Hyatt.

This genus was originally established by Hyatt (*Proc. Boston Soc. Nat. Hist.*, Vol. xxii, 1883, p. 327) to include evolute species with open umbilicus, trapezoidal or semilunular cross-section, and usually ribs or tubercles on the sides; the species included by Hyatt in this genus all have prominent siphonal saddles, first lateral saddle broadly rounded, second lateral saddle broad but inclined to be pointed; the siphonal lobes are long, narrow and pointed, and the lateral lobes broad and pointed. In all the species cited by Hyatt (*loc. cit.*) as belonging to *Gastrioceras* there is but a single pair of lateral lobes visible, that is, on the sides of the shell; and in the *Second Annual Report Geol. Survey of Texas*, 1891, p. 355, Hyatt limits *Gastrioceras* to forms with a single pair of lateral lobes and with the second pair on the umbilical shoulders. Hyatt (*loc. cit.*) refers *G. russiense* Zwetajew to his genus *Paralegoceras*, because that species has the second pair of lateral lobes on the sides of the shell and not on the umbilical shoulders. But *Gastrioceras russiense* has just the same number of lobes as all other known species of *Gastrioceras*, namely nine in all, and lacks the lobe on the umbilical border, which is characteristic of *Paralegoceras*. Another species, *Gastrioceras baylorense* White (Bull. 77, *U. S. Geol. Survey*, p. 19, Pl. ii, Figs. 1–3), also has two pairs of lateral lobes. White's figures and description do not show whether the umbilical lobe is present or not; if it is, *G. baylorense* rightfully belongs with *Paralegoceras*, but it most probably belongs in the same group as *G. russiense*. Dr. K. von Zittel, in *Grudzüge der Palæontologie*, 1895, p. 399, confines *Gastrioceras* to forms with a single pair of lateral lobes. But the relations of *Gastrioceras*, *Glyphioceras* and *Paralegoceras* have been best worked out by Karpinsky,[*] who shows that there is no marked distinction between *Glyphioceras* and *Gastrioceras;* that both have the same number of lobes and saddles—nine of each; that the second pair of lateral lobes may be on the umbilical shoulders or on the sides of the shell, thus differing from *Paralegoceras*, in which the third pair of lateral lobes is on the umbilical shoulders. *Gastrioceras* usually has a trapezoidal cross-section and umbilical ribs; but some species lack the ribs, as *G. globulosum* M. and W., while some species of *Glyphioceras* have umbilical ribs and, in their youth, also the elliptical cross-section, as *Glyphioceras diadema* Goldfuss. But the two extremes are widely separated from each other, as *Gastrioceras jossæ* Verneul and *Glyphioceras sphæricum* Martin.

---

* *Proc. Boston Soc. Nat. Hist.*, Vol. xxii, 1883, p. 322.

† *Palæontographica*, Vol. xxvii, Pl. iv, Fig. 1.

This genus has been looked upon by Steinmann[†] as the ancestor of the trachyostracan families of the Trias, the *Ceratitidæ* and the *Tropitidæ*. Dr. K. von Zittel [‡] agrees with this opinion as to the origin of the *Tropitidæ*, but thinks the *Ceratitidæ* developed out of the *Prolecanitidæ*.

Gastrioceras branneri sp. nov. J. P. Smith, Pl. xxiii, Figs. 1–6.

The adult shell is discoidal, with low, narrow whorls of semilunular cross-section; the adult whorl is very evolute, embracing not more than a third of the preceding one, and the increase in height and breadth is extremely slow. The young whorls are proportionally broader and more involute, so that the umbilicus of the younger part of the shell is deeper, but widens rapidly with age, as the involution decreases. *G. branneri* is the most evolute species of *Gastrioceras* known in the Carboniferous, and approaches the narrow evolute Permian type, described by Gemmelaro[§] from Sicily; but the Sicilian form still retains the strong constrictions, and has also acquired the spiral striæ that are characteristic of Permian *Gastrioceras*.

Dimensions.	MM.
Diameter	39.5
Height of last whorl	10.5
Width of umbilicus	19.0
Breadth	15.0
Height of last whorl from top of preceding	8.0

The specimen shows nine whorls at the diameter of 39.5 mm.

Sutures.—The sutures consist of three external lobes and as many saddles. The siphonal lobes are long, narrow, and pointed; the first lateral broadly pointed, and on the umbilical shoulder is another shallow lobe, broad and pointed. The siphonal saddle is narrow, with the usual indentation at the end; the first lateral saddle is broadly rounded and deep, the second lateral saddle shallow and inclined to be pointed. The inner lobes are three in number, a long, narrow, pointed antisiphonal lobe, and a pair of shorter, pointed lateral lobes; the four internal saddles are rounded. The figures on Pl. xxiii, Fig. 5, *a* and *b*, show the sutures to be characteristic of *Gastrioceras;* but the second lateral lobe, while on the umbilical shoulders, is plainly visible from the outside. Thus the species might be referred to the genus *Paralegoceras* of Hyatt; but it has only nine lobes and nine saddles, while *Paralegoceras* has eleven of each. For a discussion of this see p. 256 under description of the genus *Gastrioceras.*

---

[*] *Mém. Acad. Impér. Sci.*, St. Petersburg, vii Ser., Tome xxxvii, No. 2, "Ammoneen d. Artinsk-Stufe," pp. 45–48.

[†] *Elemente d. Palæontologie*, 1890, p. 393.

[‡] *Grundzüge d. Palæontologie*, 1895, p. 405.

[§] *Giorn. Sci. Nat. ed. Econ.*, Vol. xx, 1890, p. 31, Pl. D, Figs. 21–26, *Gastrioceras waageni* Gemm.

Surface Characters.—The shell is preserved on only a small portion of the specimen, but the cast shows the generic and specific characters quite as well. Obscure and somewhat doubtful constrictions were observed, but the preservation is such that their interval could not be ascertained. The umbilical shoulders are marked with rather weak nodes or ribs, which on the outer whorls reach up nearly to the abdominal shoulders; on the young shell they are relatively much stronger.

Affinities.—*Gastrioceras branneri* belongs to the group of *G. listeri* Martin, *G. jossæ* Verneul, and *G. marianum*, all characterized by trapezoidal cross-section, umbilical ribs, pointed lobes and rounded saddles, and evolute whorls. From the above-mentioned species *G. branneri* differs in the narrowness of its whorls, and wide, shallow umbilicus; it seems to depart further from the *Glyphioceras* stock than any other Carboniferous species of the genus *Gastrioceras.*

Occurrence.—*Gastrioceras branneri* was found along with *Pronorites cyclolobus* Phillips, var. *arkansiensis* J. P. Smith, in Arkansas, on Pilot mountain, Carroll county, three and a half miles southwest of Valley Springs, in 17 N., 19 W., section 18, northeast corner, in the Lower Coal Measures, so-called "Millstone-Grit" (A10 of Prof. H. S. Williams' section). About fifty-five feet below this horizon lie coarse, reddish brown, fossiliferous limestone supposed to be the Chester beds of the Lower Carboniferous.

The type, for the use of which the writer is indebted to Prof. H. S. Williams, is the property of the U. S. Geological Survey (National Museum), catalogue number Sta. 1275.

Gastrioceras globulosum Meek and Worthen. Pl. xviii, Figs. 1–6. *Goniatites globulosus* Meek and Worthen, *Proc. Acad. Nat. Sci. Phila.*, 1860, p. 47. *Goniatites globulosus* Meek, *Geol. Surv. Illinois*, ii, p. 390, Pl. xxx, Fig. 2. *Gastrioceras globulosum* M. and W., sp., A. Hyatt, *Proc. Boston Soc. Nat. Hist.*, 1883, p. 327.

This species resembles *Goniatites* (*Gastrioceras*) *baylorensis* White, of the Texas Permian, but the lobes of the latter are alone sufficient to separate the species, exceeding by one the number on the sides of *G. globulosum*. The Texas species also has the umbilicus much wider and more open, and is not so globose.

The angle of the umbilicus is 45°, which remains constant notwithstanding the fact that the shell grows more involute with age, being in its youth a comparatively open coil. In youth the whorls are flattened, but with age they become more rounded, until the shell reaches almost the form of *Glyphioceras sphæricum* Martin. As many as six whorls are known.

The deeply marked constrictions, that are so common in the family of the *Glyphioceratidæ*, are seen on the casts, about four to a whorl.

Sutures.—The sutures show nine lobes and nine saddles; the siphonal lobes are narrow and pointed, the first lateral lobe is broad, but pointed, and on the umbilical shoulder is a small, pointed "suspensive" lobe. There are three pointed, internal (concealed by the involution) lobes, of which the antisiphonal (dorsal) is the longer.

The siphonal saddle is rather deeply notched, long and narrow; the two lateral saddles are broad and rounded. The two internal saddles are rather pointed and long, as is the case with most species of this genus. The internal lobes and saddles have never been seen before in this species.

The septa are exactly like those figured by Meek and Worthen, so that no further description of them is necessary; they are typical of the genus *Gastrioceras*, as characterized by Hyatt, although, as Karpinsky* remarks, the sutures alone are not sufficient to separate the genera *Glyphioceras*, and *Gastrioceras*, since a comparison of the sutures of *Gastrioceras jossæ* Verneul and *Glyphioceras diadema* Verneul (not Goldfuss) shows the almost perfect similarity of the two.

The surface of the shell was unknown to Meek and Worthen, but some of the Arkansas specimens have the shell partially preserved. It is marked with fine, sharp, doubly arcuate, sickle-shaped striæ or ribs, with the sinus on the ventral portion pointing backwards. This surface ornamentation resembles that of *Glyphioceras obtusum* Phillips, *Geol. of Yorkshire*, ii, p. 235, Pl. xix, Figs. 10–13, but the form is much more globose, and the lobes unlike those of Phillips' species.

Dimensions.—One of the fragments shows a diameter of over two inches; on this only the body whorl was seen, it being at least one coil in length.

Dimensions of the Largest Figured Specimen.

	MM.
Diameter	36
Breadth	27
Height of last whorl	14

---

*"Ueber die Ammoneen der Artinsk-Stufe," *Mém. Ac. Imper. Sci. St. Petersburg*, vi Series, Tome xxxvii, No. 2, p. 46.

	MM.
Height of last whorl from centre of umbilicus	19
Height of last whorl from top of the inner one	8
Width of umbilicus	9

These measurements show the adult shell to be very globose.

Position and Locality.—Several specimens of this very interesting species were found in the Upper Carboniferous of Scott county, Arkansas, 1 N., 28 W., section 4, southeast quarter of southeast quarter, in beds supposed to belong to the Barren Coal Measures; but from this and associated fossils seem more likely to belong to the Upper Coal Measures. This species is also found in the Cisco division of the Texas Upper Coal Measures.

Gastrioceras excelsum Meek, Pl. xvii, Fig. 1. *Goniatites globulosus* var. *excelsus* Meek, Bull. *U. S. Geol. and Geog. Survey Terr.*, No. 6, second series, p. 445. *Goniatites globulosus* Meek and Worthen (pars), *Geol. Surv. Illinois*, Vol. ii, p. 390, Fig. 38.

This species was originally described from the Upper Coal Measures of eastern Kansas, from Osage, associated with *Spirifer cameratus* Morton, and *Athyris subtilita* Hall, and other species characteristic of that horizon.

It resembles closely in everything but size *Gastrioceras globulosum* Meek and Worthen of the Upper Coal Measures of Illinois, and we know too few specimens of the latter species to say that it did not grow to the immense size of the Kansas species.

In the Lower Coal Measures of Pope county, Arkansas, 10 N., 20 W., section 8, southeast quarter of northwest quarter, was found a large septate fragment of a specimen that must have been five or six inches in diameter, since the body chamber is at least one coil in length on all nearly related species. The ventral (external) portion of the shell is higher and not so rounded as in *G. globulosum*, but as has already been noticed on that species the coil becomes with age rounder and more elevated, and this may be only an advanced stage of growth not seen on any of the smaller specimens. The lobes are almost exactly like those of the small *Gastrioceras globulosum* of Meek and Worthen.

Gastrioceras marianum Verneul, Pl. xvi, Figs. 1–5. *Goniatites marianus* Verneul, *Geol of Russia*, ii, p. 369, Pl. xxvii, Fig. 2. *Goniatites jossæ* Verneul (pars), Eichwald, *Leth. Ross.*, i, p. 1324. *Goniatites listeri* Martin (pars), var. *mariæ*, Gurow, *Abhandl. d naturf. Gesell. Charcow*, 1873, p. 87. *Gastrioceras marianum* Verneul; Karpinsky, *Ammoneen der Artinsk-Stufe*, p. 49.

This is easily distinguished from all other American species by its low, broad whorl, wide and deep umbilicus, and the strong ribs on the umbilical shoulders. These together with its sutures make it a most typical representative of the genus *Gastrioceras.* But there are species of *Gastrioceras* that are globose and not flattened, and without the umbilical ribs or nodes ; also certain species have their sutures very angular. On the other hand certain species of *Glyphioceras* have weak umbilical nodes and rounded sutures.

This species is so closely related to *Gastrioceras listeri* Martin, sp., *Petrif. Derb.*, Pl. xxxv, Fig. 3, that they have been united by Gurow. Others still are inclined to unite it with *Glyphioceras diadema* Goldfuss, while many would join it with *Gastrioceras jossæ* Verneul.

From *G. jossæ* it differs in the almost total absence of spiral ribs or striæ, and in the wider and more angular umbilicus, but they are so similar that *G. marianum* may be considered the ancestor of *G. jossæ.*

The best mark of separation from *G. listeri* is the greater number of coils which *G. marianum* has, as many as seven being known on a specimen of less than one inch in diameter.

G. kingii Hall and Whitfield, *U. S. Expl. Fortieth Parallel,* iv, p. 279, Pl. vi, Fig. 9–14, is a closely related form, but differs in having the umbilical slope a little more gentle, the angle with the axis of the shell being 40–45°, while that of *G. marianum* is about 37°. *G. kingii* has fewer whorls to the same diameter. *G. marianum* also has the external saddle not so deeply divided, and the two siphonal lobes are wider and become somewhat broadened at the ends. The ribs on the sides of *G. marianum* are much stronger. Weak spiral striæ are seen on the inner whorls.

The transverse lines of growth form incipient undulations on the ventral portion of the shell. Strong constrictions occur both on the cast and on the shell, on the body chamber, as well as on the rest of the chambers, becoming weaker with age ; their number is about three to a whorl, and they curve forward, with a gentle sinus pointing backward.

The ribs are strong on the sides, forming sharp nodes or tubercles, and are continued across the ventral portion by fine undulations. Towards the centre or umbilicus the ribs weaken very suddenly. The sutures are like those figured by Verneul, but show also the small "suspensive" lobe on the umbilical border, as described and figured by Karpinsky.

The body chamber is at least one coil in length.

Dimensions.—Some fragments indicate a size of not less than two and a half inches in diameter. The most perfect specimen has the following dimensions :

	MM.
Height of last whorl	9
Diameter	30
Width of umbilicus	14

The breadth of the last whorl is about two-thirds of the diameter of the shell. Angle of umbilicus with the axis of the shell about 37°. These measurements agree very well with those given by Karpinsky.

The smallest of the Arkansas specimens gave the following dimensions:

	MM.
Diameter	8.5
Height of last whorl	2.5
Width of umbilicus	4.5
Breadth of last whorl	6.0

These measurements agree closely with the measurements Karpinsky gives of small specimens from the Urals. The proportions would be

Diameter	1.00
Height of last whorl	0.29
Width of umbilicus	0.53
Breadth of last whorl	0.70

These proportions agree very well with those given by de Verneul, *Geol. Russie d'Europe et des Mont. de l'Oural*, Vol. ii, p. 369.

Occurrence.—This species was originally described by Verneul from the Upper Carboniferous limestone of Schartymka in eastern Russia, C2, and does not occur in the Artinsk or Lower Permian deposits, although it has been confused by many authors with *Gastrioceras jossæ*, which is characteristic of those strata. Karpinsky, in his monograph on the *Ammoneen der Artinsk-Stufe*, pp. 50 and 51, describes the differences that separate *G. marianum* from *G. jossæ* and *G. listeri;* the most striking of these distinctions is that on *G. marianum* the constrictions have a weak sinus pointing backward, while on the others it is forward.

We have therefore at least some evidence of an Upper Carboniferous sea, stretching from the Ural mountains eastward to the Mississippi valley. This would help to explain the fact that our marine Carboniferous fauna has more analogy to the Asiatic than to the western European fauna of the same age.

G. marianum was found in the Upper Coal Measures in Scott county, Ark., 1 N., 28 W., section 4, southeast quarter of southeast quarter. This, or a very closely related species, occurs also in the Cisco division of the Upper Coal Measures of Texas.

Gastrioceras, sp. indet. Pl. xx, Fig. 1.

In the young stages this species resembles closely *G. marianum* Verneul, but the umbilicus is narrower. The young whorl has also a trapezoidal cross-section, each succeeding whorl becoming more highly arched, until all resemblance to the Ural species is lost in the adult stage.

The coil, too, shows decidedly the phenomenon called by Mojsisovics "egression," by which is meant a change in the direction of the spiral accompanied by widening of the umbilicus, so that with age it flares open. Even with the wide umbilicus of the adult stage, this species is easily distinguished from *G. marianum* by its narrower and more highly arched whorls.

The sides of the whorl are ornamented with strong tubercles, which on the young stages are like those of *G. marianum*, but on the adult form ribs reach halfway from the umbilical shoulders to the ventral portion of the shell.

Constrictions are seen on the cast, about three or four to a revolution. The surface of the shell is not known. The sutures are like those of *G. marianum*, but the siphonal or external lobes are somewhat broader, and the lateral lobes are longer, narrower and more pointed.

The lateral saddle is broad, rounded and considerably shorter than the lateral lobes. There is also a small auxiliary or "suspensive" lobe on the umbilical shoulders, like that of *G. marianum*. The sutures resemble still more closely those of *Glyphioceras diadema* Goldfuss as figured and described by DeKoninck in *Description des Animaux Fossiles Terr. Carbonif. Belgique*, p. 574, Pl. 1, Fig. 1, e. But the Belgian species is considerably more involute, has a lower whorl, and proportionally narrower umbilicus. Also the umbilical ribs are much weaker than on the Arkansas species.

Verneul, in *Géol. Russie d'Europe et des Mont. Oural*, Vol. ii, p. 367, has described a goniatite as *G. diadema*, but this form is less like the Arkansas species than the Belgian form. In addition to this, there is no likelihood that all the forms referred to *G. diadema* are really one species. It is quite possible that the Arkansas species may be identical with one of the many varieties ascribed to *G. diadema*, but at present it is impossible to prove this.

Occurrence.—Several badly broken casts and moulds were found in the Upper Coal Measures of Scott county, Arkansas, 1 N., 28 W., section 4, southeast quarter of southeast quarter, associated with *Gastrioceras marianum* Verneul, *G. globulosum* Meek and Worthen, *Pronorites* sp., etc.

Genus PARALEGOCERAS, Hyatt. *Paralegoceras iowense* Meek and Worthen, Pl. xix, Figs. 1–3. *Goniatites iowensis* Meek and Worthen ; *Geol. Surv. of Illinois*, Vol. ii, p. 392, Pl. xxx, Fig. 3. *Paralegoceras iowense* M. and W , Hyatt, *Proc. Boston Soc. Nat. Hist.*, Vol. xxii, 1883, p. 327. *Paralegoceras iowense* M. and W., Hyatt, *Geol. Survey of Texas, Fourth Ann. Report*, 1893, p. 474, Figs. 52–55. *Goniatites missouriensis* Miller and Faber, *Journ. Cincin. Soc. Nat. Hist.*, Vol. xiv, p. 164, Pl. vi, Fig. 1.

The genus *Paralegoceras* is extremely rare, being known heretofore only from the Coal Measures of Iowa, the Upper Carboniferous and Artinsk beds of Russia, and the Bend Formation of Texas, and in the Upper Coal Measures near Kansas City, Missouri.

The Arkansas specimen is a septate cast that when complete must have been at least four inches in diameter. The whorl is broader and rounder than on the Iowa specimen, but this is to be expected on a young individual since the evolution of most of these forms takes place after this manner. The whorls are quite involute and the umbilicus is narrow on the young shell, becoming wider as the shell grows older. The surface of the cast is smooth, no constrictions or other ornamentations appearing on the older shell. But on the younger shell the umbilical shoulders show faint ribs, that shade off into fine undulations on the sides. Hyatt has shown the same thing in *Geol. Survey Texas, Second Ann. Report*, p. 355. But in Texas specimen the ribs persist to a much later stage than on that from Arkansas.

Dimensions.—Although the specimen was not well preserved, the measurements of the entire form could be taken. They were as follows:

	MM.
Diameter	55.5
Height of last whorl from umbilicus	25.5
Height of last whorl from top of inner whorl	17.0
Width of umbilicus	13.5

An inner coil taken out of the same specimen gave the following measurements:

	MM.
Diameter	28.5
Height of last whorl from umbilicus	12.0
Height of last whorl from top of inner whorl	7.5
Width of umbilicus	6.0

These show the inner coils to be much lower, less highly arched, and less embracing than the outer ones.

Surface Markings.—On the inner whorls a trace of the shell is preserved, and is like that figured by Hyatt. The undulating striæ are like those common on the *Glyphioceratidæ*.

Sutures.—The sutures are like those figured by Meek and Worthen, but the siphonal saddle is notched by a small siphonal lobe. The three external lateral saddles are broadly rounded, while the lobes are sharply pointed. The lobes are eleven in number, three on each side, one on each umbilical shoulder (suspensive lobe) and three internal, that is, covered by the involution. The interior lateral lobes and the antisiphonal lobe (dorsal) are very sharp and long. These have not been seen before on this species. The sutures approach very closely to those of *Gastrioceras russiense* Zwetajew, but *Paralegoceras iowense* has one more pair of lobes than the Russian species and has also a suspensive lobe on the umbilical shoulders. In the latter characteristic *Paralegoceras iowense* resembles *P. tschernyschewi* Karpinsky (*Ammoneen der Artinsk-Stufe*, p. 62, Pl. iii, Fig. 1). Karpinsky (*loc. cit.*), has emended Hyatt's genus to embrace those forms with two lateral lobes and a "suspensive" lobe on the umbilical shoulders. Hyatt, in the *Geological Survey of Texas, Second Annual Report*, 1891, p. 355, emended the genus *Paralegoceras* to include those forms with the second lateral lobe on the umbilical shoulders, and he included in it *Gastrioceras russiense* Zwetajew. But the Russian species has the suspensive lobe on the side and has only nine lobes in all, and thus ought to remain in the group characterized as *Gastrioceras*.

In the *Fourth Annual Report of the Geological Survey of Texas*, 1893, p. 474, Hyatt has described under the name of *Paralegoceras iowense* Meek and Worthen, a goniatite from the Bend Formation of Texas. But the lobes are not exactly like those of the Iowa Coal Measures species, the third lateral saddle is on the umbilical shoulders, and the young shell is marked with ribs which form well-defined tubercles, even on the older shell. These differences were explained by the supposition that the Texas specimen was the young of *Paralegoceras iowense*, and might thus naturally show them. But since the Arkansas specimen is a young one and still shows all the characteristics of the adult, it becomes very likely that the Texas specimen belongs to another species.

There is also another reason why this is probable. The Bend Formation is called Coal Measures by the Geological Survey of Texas, but its fauna seems to be identical with that of the Fayetteville shale of Arkansas, which belongs to the Lower Carboniferous, and probably to the Warsaw or St. Louis division. Species that are almost certainly identical with *Glyphioceras incisum* Hyatt and *G. cumminsi* Hyatt have been collected in the Fayetteville shale of Arkansas. And since these goniatites have unusually only a limited stratigraphic range, it is very probable that the species from the Bend Formation is not identical with that from the Coal Measures.

Occurrence.—A single specimen of *Paralegoceras iowense* was found in Arkansas, in the Lower Coal Measures of Conway county, 5 N., 16 W., section 17, near centre of north half. The species was originally described from the Coal Measures of Iowa and since then has not been cited from any other locality up to the present occurrence, unless the Texas species of Hyatt should be the same. There can, however, be very little doubt that *Goniatites missouriensis* Miller and Faber (*Journ. Cincinnati Soc. Nat. Hist.*, Vol. xiv, p. 164, Pl. vi, Fig. 1), from the Upper Coal Measures of Missouri, near Kansas City, is identical with *Paralegoceras iowense* Meek and Worthen.

Family *Prolecanitidæ* Hyatt.

The *Prolecanitidæ*, as originally described by Hyatt,* included certain elements that do not belong to this stock; but, as revised by Karpinsky,† it forms the most perfect genetic series known, radiating from the common radicle, *Ibergiceras*, in several parallel series or subfamilies, including the *Medlicottinæ*, the *Noritinæ*, and the *Lecanitinæ* of the Permian and Trias, the *Pinacoceratidæ* of the Trias, and the *Amaltheidæ* of the Trias, Jura and Cretaceous.

---

* *Proc. Boston Soc. Nat. Hist.*, Vol. xxii, p. 331.

† *Ammoneen der Artinsk-Stufe*, pp. 41-45.

Dr. K. von Zittel* says that this family probably also gave rise to the *Ceratitidæ* of the Permian and Trias.

Genus **PRONORITES**, Mojsisovics.

In the adult stage *Pronorites* is discoidal, has high, narrow whorl, with nearly parallel sides, is very involute, and has narrow umbilicus.

The siphonal lobe is three-pointed, the first lateral lobe divided into two or three parts by secondary sinuses. In addition to these there are several auxiliary lateral lobes, three to six, all slightly pointed, while all the saddles are rounded. No constrictions or other surface ornamentations are known, except that on the adult body-chamber faint ribs have been observed.

The first septum of *Pronorites* is latisellate, and the broad sinus is soon divided by a siphonal lobe into two lateral sinuses (Pl. xxiii, Fig. 7). This is the end of the embryonic stage, in which the shell is seen to belong to an ammonoid cephalopod, but the family is not yet indicated.

In the next stage the lateral sinuses are subdivided by broad, rounded lobes; the sutures then resemble those of *Goniatites* (*Ibergiceras*) *tetragonus* Roemer of the Upper Devonian, and the shell is in the beginning of the larval or nepionic stage (Pl. xxiv, Fig. 9*a*); a little further on the sutures are like those of a *Prolecanites* (*P. serpentinus* Phillips), and the larval stage is approaching its end.

In the following or neanic stage the siphonal lobe becomes three-pointed, and the shell corresponds to *Paraprolecanites* Karpinsky,† and its family affinities are beyond doubt (Pl. xxiv, Fig. 9*b*).

With the adult or ephebic stage the first lateral lobe becomes divided into two or three parts (Pl. xxiv, Fig. 9*c–f*). With this stage the genus *Pronorites* stops. But Gemmellaro‡ has described from the Permian of Sicily a further development of this form in the genus *Parapronorites*, in which the double lateral lobe and some of the simple ones become serrated.

Another line of development of *Pronorites* has been described by Gemmellaro (*op. cit.*) as *Sicantes*, in which all the lateral lobes become double like the first one. The next higher stages are given by *Medlicottia* Waagen, in which the siphonal saddles become indented and ammonitic. Karpinsky§ shows that *Medlicottia* in its development goes through the *Ibergiceras*, *Prolecanites*, *Paraprolecanites*, *Pronorites*, *Sicanites* and *Promedlicottia* stages.

---

* *Grundzüge der Palæontologie*, 1895, p. 400.

† *Ammoneen der Artinsk-Stufe*, p. 7.

‡ *Fauna Calc. Fusulina d. Valle d. fium Sosio*, 1887, p. 60.

§ *Ammoneen der Artinsk-Stufe*, p. 41.

Thus the finding of *Pronorites* in Arkansas is of great importance, since it is the ancestor of a form *Medlicottia*, which though unknown in Arkansas, has been found at no great distance away in the Texas Permian.* *Pronorites*, on the other hand, has not yet been found in Texas.

These occurrences help to prove the continuity of life from the Carboniferous into the Permian, and to show that the same conditions existed here as in the Artinsk region of the Ural mountains, where the Carboniferous beds contain the goniatites out of which most of the Permian ammonites were developed.

Pronorites cyclolobus Phillips, variety *arkansiensis* J. P. Smith, Pl. xxiv, Figs. 1–4. *Goniatites cyclolobus* Phillips, *Geol. Yorkshire*, Vol. ii, p. 237, Pl. xx, Figs. 40–42. *Goniatites cyclolobus* Phillips, Verneul, *Geol. Russia and the Ural Mountains*, Vol. ii, p. 370, Pl. xxvi, Fig. 4. *Goniatites cyclolobus* Phillips, Roemer, *Palæontographica*, ix, p. 167, Pl. xxvii, Fig. 1. *Goniatites cyclolobus* Phillips, DeKoninck, *Faune calc. Carb. Belg.*, Vol. ii, p. 121, Pl. l, Figs. 5, 6. *Pronorites cyclolobus* Phillips, (variety *uralensis*) Karpinsky, *Mém. Acad. Impér. Sci. St. Petersbourg*, vii series, Tome 37, No. 2, p. 8, Pl. i, Fig. 4.

Phillips' original description of *Goniatites cyclolobus* is as follows: "Discoid, sides flat, back broad, inner whorls half concealed, septa with four round lateral lobes, a small double dorsal lobe, and small acute dorsal sinuses, the first lateral sinus double, the others simple, all round."

This description is too meagre to be of more than generic value, and also the term "dorsal" is used where now "abdominal" is in common use.

The shell is smooth, discoidal, very involute. The sides are nearly parallel and the breadth increases very slowly; the abdominal shoulders are nearly square, and the abdomen flat. The whorls are deeply embracing and increase rapidly in height. The umbilical shoulders are square, the umbilicus narrow and deep, and increases slowly in diameter.

Dimensions.—The specimen, which was septate throughout, gave the following dimensions:

	MM
Diameter	34.0
Height of last whorl from umbilical shoulders	17.5
Breadth	10.0
Width of umbilicus	7.0

This gives the proportions: 1: 0.5: 0.29: 0.20: which agree almost exactly with Karpinsky's figures, 1: 0.5: 0.30: 0.20. On the Arkansas specimen the involution is shown by the height of the last whorl from the top of the next inner one, 12.5 mm. as compared with the total height of the whorl which is 17.5 mm. No measurements of this relation were shown on the Russian specimen.

---

* C. A. White, *Bull.* 77 *U. S. Geol. Survey*, p. 21.

This description applies only to the adult shell, the relative measurements of the nepionic and neanic shells being very different. The Arkansas specimen showed only the last whorl, but the young stages have been worked out by Karpinsky,* from whose work the following description is translated: "Around the cylindrical embryonic chamber (Pl. xxiii, Fig. 8) are coiled very evolute whorls, whose involution increases gradually, but at first only in slight measure (Pl. xxiv, Fig. 8)· So, for example, the fourth whorl embraces at the beginning only about one-fourth of the preceding; thus the height of the evolute portion of this fourth whorl is six or seven times as great as that of its own involute portion.

With later stages of growth the involution increases so that the whorls become finally completely embracing, and probably conceal a portion of the umbilicus. Because of this mode of growth the umbilicus appears at first broad, and increasing rapidly, then only gradually, and finally not at all, while the whorl continues to grow in height with great rapidity. Thus, at a diameter of the whorl of four or five millimeters, the umbilicus is about one-half of the total diameter, and at thirty mm. only about one-fifth. The first and second whorls have a broad elliptical cross-section (Pl. xxiv, Fig. 8), while that of the succeeding whorls becomes higher, with the long elliptical axis vertical (Pl. xxiv, Fig. 6), and then finally the flanks are bounded by almost parallel lines and the siphonal side is only slightly arched."

Ontogeny. According to Karpinsky,† the first or typembryonic stage is latisellate, that is the suture consists of a broad abdominal saddle; this saddle is next divided by a broad siphonal lobe (Pl. xxiii. Fig. 7).

The next stage corresponds to the genus *Ibergiceras* Karpinsky, of which *Gon. tetragonus* Roemer, of the Upper Devonian, is the type; in this the whorls are broad, low and only slightly embracing, the umbilicus wide and shallow. The sutures consist of a long rather narrow siphonal lobe, and two broadly rounded lateral lobes. This is the nepionic or larval stage (Pl. xxiv, Fig. 9*a*). In the continuation of this stage the whorls become higher, and the lobes more complicated, corresponding to the genus *Prolecanites*, of which *Gon. henslowi* Phillips and *Gon. serpentinus* Phillips are types.

In the next stage the shape of shell does change materially, but the siphonal lobe becomes three-pointed (Pl. xxiv, Fig. 9*b*); this is the neanic or youthful stage, and corresponds to the genus *Paraprolecanites* Karpinsky, of which the type is *Gon. mixolobus* Sandberger (not Phillips) (*Verstein, Rhein. Schichten-System in Nassau*, p. 67, Pl. iii, Fig. 13?; Pl. ix, Fig. 6).

The further development consists in the division of the first lateral lobe by a secondary saddle; the shell is then in the ephebic or adult stage, and in *Pronorites* gets no higher in its development.

---

* *Ammoneen der Artinsk-Stufe*, p. 8.

† *Op. cit.*, p. 4 *et seq.*

The sutures are then constant in shape, and consist of a three-pointed siphonal lobe, a first lateral lobe deeply divided by a secondary saddle and five secondary lateral lobes outside the umbilical border, and one on the umbilical shoulder. All the lobes are pointed, and the saddles rounded. The inner lobes, covered by the involution, are unknown.

The sutures, as figured on Pl. xxiv, Fig. 4, show some differences from those figured by Phillips, Pl. xxiii, Fig. 9, and by Karpinsky,[*] Pl. xxiv, Fig. 9*f*. On the Arkansas specimen the three-pointed siphonal lobe is longer than on the type of Phillips, or the variety *P. cyclolobus*, variety *uralensis* Karpinsky, the secondary sinus on the first lateral lobe is deeper, and the second lateral lobe is proportionally longer. In this the Arkansas specimen does not depart further from the type than the variety *uralensis*. But if this difference should be thought to be of sufficient importance to characterize a new variety, the name *P. cyclolobus* Phillips, variety *arkansiensis* is proposed.

Surface Markings.—The shell is smooth and devoid of constrictions or other ornamentation, but on the body chamber of the adult, Karpinsky[†] observed weak ribs, that are stronger on the abdomen and grow weaker towards the umbilicus.

Affinities.—This species is certainly a variety of *Pronorites cyclolobus* Phillips (*Geol. Yorkshire*, Vol. ii, p. 237, Pl. xx, Figs. 40–42), but is more involute at the corresponding diameter, and has a narrower umbilicus and a greater number of lateral lobes. Specimens described by De Koninck[‡] from Belgium, and by Roemer[§] from the Hartz mountains in Germany, agree perfectly with the type of *Pronorites cyclolobus;* the English, Belgian and German beds, in which the species was found, are all older than the Lower Coal Measure horizon in Arkansas in which it was found, and considerably older than the Upper Carboniferous limestone, in which it was found in the Ural mountains From this Karpinsky[‖] thinks the variety *uralensis* represents a mutation from the type of the species.

The form from the Pyrenees described by Barrois[¶] as *Pronorites cyclolobus* Phillips has been shown by Karpinsky[**] to be a new species, *P. barroisi* Karpinsky. This form is more evolute than even the type of *P. cyclolobus*, and its lobes and saddles are broader and also less numerous.

Occurrence.—*Pronorites cyclolobus* Phillips, variety *arkansiensis* J. P. Smith, was found with *Gastrioceras branneri*, sp., nov. J. P. Smith, in

---

[*] *Ammoneen der Artinsk-Stufe*, Pl. I, Fig. 4 l.

[†] *Op. cit.*, p. 9, Pl. I, Fig. 4 c and *d*.

[‡] *Faune du Calc. Carbon Belgique*, Vol. ii, p. 121, Pl. 1, Figs. 5 and 6.

[§] *Palæontographica*, Vol. ix, p. 167, Pl. xxvii, Fig. 1.

[‖] *Ammoneen d. Artinsk-Stufe*, p. 10.

[¶] *Recherches s. l. terr. anc. d'Asturies et de la Galice*, 1882, p. 295, Pl. xiv, Fig. 2.

[**] *Loc. cit.*

Arkansas, on Pilot mountain, Carroll county, three and a half miles southwest of Valley Springs, in 17 N., 19 W., section 18, northeast corner, in the Lower Coal Measures, so-called "Millstone Grit." The beds are called A 10 in Prof. H. S. Williams' section; below them lie fifty-five feet of micaceous sandstones and shales (A 9 of the section), and below that coarse, reddish-brown fossiliferous limestone, supposed to represent the Chester horizon of the Lower Carboniferous.

The type figured on Pl. xxiv, Figs. 1–4, is the property of the United States Geological Survey (National Museum), catalogue number Sta. 1275. The writer is indebted to Prof. H. S. Williams for the use of the type.

Other Localities.—*Pronorites cyclolobus* has been found in England in the upper part of the Mountain limestone; in Belgium in the limestone of Visé; in the Kohlenkalk of the Hartz, in Germany, and the variety *uralensis* has been found in Russia in the Upper Carboniferous limestone of the Ural mountains in C 2 of the section.

Pronorites, sp. indet., Pl. xx, Fig. 2.

In the Upper Coal Measures beds of Scott county, Arkansas, 1 N., 28 W., section 4, southeast quarter of southeast quarter, was found a single fragment that seems to belong to this genus. It is septate, and must have belonged to an individual about two and a half inches in diameter. The sides are smooth and little embracing and almost parallel; the coil is thin and discoidal, and the ventral or external portion seems to be only slightly arched. From the umbilicus towards the ventral portion are seen five lateral lobes that are long and pointed, the saddles being somewhat rounded. The siphonal lobe and part of the first lateral lobe are not seen, that part of the shell being worn so that they cannot be made out, but enough of the first lateral lobe is visible to show the secondary saddle that divides it. The septa are very close together, as seems to be the case on all species of this genus.

The nearest known relative is *Pronorites cyclolobus* Phillips, var. *uralensis* Karpinsky, *Die Ammoneen der Artinsk-Stufe*, p. 8, Pl. i, Fig. 4. The lobes figured on Pl. i, Fig. 4, of Karpinsky's monograph are very like those of the specimen from Scott county, and the general shape of the coil, the height and the amount of the involution are about the same on both.

Class *Crustacea*.

Order *Trilobitæ*.

Genus PHILLIPSIA, Portlock. *Phillipsia cliftonensis* Shumard, Pl. xxii, Fig. 5. *Phillipsia cliftonensis* Shumard, *Trans. St. L. Ac. Sci.*, Vol. i, p. 226. Compare *Phillipsia scitula* Meek and Worthen, F. B. Meek, *U. S. Geol. Surv. Nebraska*, p. 238, Pl. vi, Fig. 9.

A single well-preserved pygidium seems to belong to Shumard's species. It is longer than wide, semi-elliptical. The axis is very prominent, has from thirteen to fourteen segments, and the furrows on each side are deep. The segments on the lateral lobes are sharply defined and are eight in number; Shumard mentions only seven on his specimen, but that slight difference is no obstacle to identity of species, since the number varies with age. These lateral segments do not reach the border, but terminate in a lateral furrow which surrounds the pygidium. The species is closely related to *P. scitula* Meek and Worthen, but that species has only eleven axis segments and seven on the sides. Meek was of the opinion that the specimen described as *P. scitula* in *U. S. Geol. Surv. Nebraska*, p. 238, might very possibly belong to *P. cliftonensis*, but Shumard had seen only a pygidium and had no means of characterizing the rest of the body.

Phillipsia major Shumard, figured by Meek in *U. S. Geol. Surv. Nebraska*, Pl iii, Fig. 2, grows much larger than our specimen, and has twenty-two to twenty-three segments on the axis and twelve to thirteen on the sides. These end abruptly at the lateral furrow, which is much wider than that on *P. cliftonensis*.

Occurrence and Locality.—A single well-preserved pygidium was found in the Upper Coal Measures of Poteau mountain, Indian Territory, associated with a fauna similar to that of the Upper Coal Measures or Permo-Carboniferous of Nebraska.

Phillipsia (*Griffithides*) *scitula* Meek and Worthen, *Proc. Ac. Sci. Phila.*, 1865, p. 270, and *Paleont. Ill.*, Vol. v, p. 612, Pl. xxxii, Fig. 3.

A pygidium from the Lower Coal Measures of White county, Arkansas, 9 N., 4 W., section 6, and another from similar strata in 9 N., 5 W., section 1, show the characteristics of this species, but are too imperfect to figure

Phillipsia, sp.

In the Lower Coal Measures of Johnson county, Arkansas, 11 N., 24 W., section 26, southeast quarter of southwest quarter, was found a pygidium of Phillipsia that could not be identified with certainty, although it probably belongs to one of the known species.

Phillipsia (*Griffithides*) *ornata* A. W. Vogdes, Pl. xxii, Fig. 6. *Griffithides ornata* A. W. Vogdes, *Proc. Cal. Acad. Sci.*, Ser. ii, Vol. iv, p. 589, "Notes on Palæozoic Crustacea, No. 4. On a New Trilobite from Arkansas Lower Coal Measures," by A. W. Vogdes.

The following description is copied from an advance sheet kindly furnished by Capt. Vogdes:

"The only specimen of this new species was discovered in Conway county, Arkansas, and consists of a head shield which is unfortunately not quite perfect, only exhibiting the right side and part of the glabella, with portions of the thorax and an entire pygidium; but it shows sufficient new characters to authorize us in considering it as a new species.

"The head shows that the latero-posterior angles are produced into short spines extending to about the third segment of the thorax, the glabella is pyriform, gibbous in front, and destitute of lateral furrows; basal lobes prominent. The posterior border of the glabella has two small, round nodes. The cervical lobe is broad and well marked, much broader than the axial lobes.

"The thorax exhibits imperfectly parts of the pleuræ and also the axis. Thorax with nine segments. The axis shows a series of nodes running through the centre of each ring. The pleuræ are smooth, each pleural groove extending slightly beyond the fulcral point; the extremities are probably rounded, but this is not indicated by the imperfect specimen now before us.

"The pygidium exhibits both in the axis and lateral lobes distinct segmentation. The axis does not extend to the posterior margin. The entire pygidium is surrounded by a marginal border, which widens out slightly anteriorly.

"The tail is parabolic in form, very convex and not as broad as the head, measuring on its anterior border 12 mm. The axis is broad, conical and prominent, occupying a little less than one-third the width of the tail on the anterior margin. It is marked with eleven rings; these become smaller and smaller and end in an obtuse point. Each ring is distinctly ornamented along the centre by a series of nodes, arranged into three double rows of two each. The sides of the axis are smooth.

"The lateral lobes are slightly flattened on top to the fulcral point. They are marked with seven pleuræ; the grooves between the pleuræ are deep and distinct, each being rounded on top and ornamented with a single node at the fulcral point; here they bend suddenly and join the marginal border.

"*Locality and Position.*—Lower Coal Measures, T. 5 N., R. 16 W., section 17, near centre of northwest quarter of the section, Conway county, Arkansas. From the collection of the Geological Survey of Arkansas.

"*Affinities and Differences.*—This species in some of its features resembles *Phillipsia rœmeri* Möller (*Ueber die Trilobiten Steinkohlenformation des Ural*, Pl. ii, Fig. 17), especially in the markings of the tail, which shows seven pleuræ ornamented by a single node at the fulcral joint, but it differs in form and especially in the marking of the axial lobe, so much so that it could not be placed under Möller's species. There is also a resemblance of this species with ***Phillipsia*** (***Griffithides***) ***scitula*** Meek and Worthen, from the Illinois Coal Measures. It has the same number of rings in the axis of the tail, and the same characteristic pleuræ and ornamentation, but the Arkansas species differs greatly in size and also in the number of pleuræ, seven instead of six. The axis is not as wide as in *Griffithides scitula* and not distinctly flattened on each side. The limb, although moderately wide and smooth, is not depressed or nearly flat, but convex. Secondly, the ornamentation of the axis is entirely different, so much so that it would not warrant its reference to the Illinois species.

"It is doubtful in our present state of knowledge whether *Phillipsia* (*Griffithides*) *scitula* M. and W. should not be referred to the older name of *Phillipsia cliftonensis* Shumard, from the Upper Coal Measures, Clifton Park, Kansas, described from a pygidium. Dr. Shumard says that the axis has from thirteen to fourteen subgranulose rings and seven side segments. A thorough study of all these allied species may necessitate their reference to the older name; but for the present it would be advisable to give the Arkansas species a new name on account of the ornamentation of its tail."

Class *Arachnoidea.*

Order *Xiphosura.*

Genus undetermined. PRESTWICHIA ?

In the Lower Coal Measures of White county, Arkansas, 9 N., 4 W., section 6, was found the mould of a part of the body of a crustacean that seems to belong to the family of the *Hemiaspidæ*, and yet differs from all known genera of this family in being armed with two rows of spines instead of only one.

Too little of the body is known for a generic description.

	Fauna of the Coal Measures of Arkansas.	Lower Carboniferous.	Lower Coal Measures.	Upper Coal Measures.	Locality in Arkansas.	Other Localities.	
	BRYOZOA.						
1	*Fenestella shumardi* Prout.	X		X	Poteau mountain, Indian Territory; Stone county, Arkansas, in Boone chert, 15 N., 12 W., Sec. 27.	Lower Coal Measures, Ohio; Upper Coal Measures, Nebraska.	1
2	*Rhombopora lepidendroides* Meek.			X	Poteau mountain, Indian Territory.	Upper Coal Measures, Nebraska, China.	2
3	*Septopora biserialis* Swallow.			X	Poteau mountain, Indian Territory.	Permo-Carboniferous, Kansas and Nebraska; Upper Coal Measures, Nebraska; Upper and Lower Coal Measures and Lower Carboniferous, Illinois; Upper Carboniferous, Arizona.	3
	ANTHOZOA.						
4	*Fistulipora nodulifera* Meek.			X	Sebastian county, 8 N. 32 W., Sec. 12: Poteau mountain, Indian Territory.	Upper Coal Measures, Nebraska, Iowa, Illinois.	4
5	*Lophophyllum proliferum* McChesney.			X	Poteau mountain, Indian Territory.	Coal Measures, Nebraska, Texas, Illinois, China, etc.	5
6	*Zaphrentis*, sp.			X	Crawford county, 10 N., 30 W., Sec. 10.		6
7	*Zaphrentis*, sp.		X		Conway county, 5 N., 16 W., Sec. 17.		7
	ECHINODERMATA.						
8	*Cyathocrinus*, sp.			X	Scott county, 1 N., 28 W., Sec. 4.		8
9	*Erisocrinus* (*Ceriocrinus*) *inflexus* Geinitz.			X	Poteau mountain, Indian Territory.	Coal Measures, Utah, Nebraska, etc.	9
10	*Hydreinocrinus mucrospinosus* McChesney.			X	Poteau mountain, Indian Territory.	Coal Measures, Mississippi valley.	10

	Fauna of the Coal Measures of Arkansas.	Lower Carboniferous.	Lower Coal Measures.	Upper Coal Measures.	Locality in Arkansas.	Other Localities.	
	ECHINODERMATA—Continued.						
11	*Poteriocrinus*, sp.			X	Poteau mountain, Indian Territory.		11
12	Crinoid stems, genus (?).		X		Pope county, 10 N., 20 W., Sec. 8.		12
13	Crinoid stems, genus (?).		X		White county, 8 N., 7 W., Secs. 33 and 26.		13
	BRACHIOPODA.						
14	*Athyris subtilita* Hall.	X	X	X	Sebastian county, 8 N., 32 W., Sec. 12; Poteau mountain, Indian Territory; Conway county, 6 N., 16 W., Sec. 29; in Boone chert, Stone county, 14 N., 10 W., Sec. 9.	Permo-Carboniferous of Kansas and Nebraska; world-wide in Coal Measures and Lower Carboniferous.	14
15	*Orthis* conf. *resupinoides* Cox.		X		White county, 8. N., 7 W., Sec. 33; Conway county, 8 N., 17 W., Sec. 33.	Coal Measures, Kentucky; Upper Carboniferous, New Mexico.	15
16	*Orthis pecosii* Marcou.	?	X	X	Poteau mountain, Indian Territory; Conway county, 6 N., 16 W., Sec. 29, southwest quarter of southwest quarter; Boone chert, Stone county, 14 N., 10 W., Sec. 9 (?).	Upper Coal Measures, Mississippi valley; New Mexico, China, India; Lower Carboniferous in California (?).	16
17	*Productus cora* d'Orbigny.	X		X	Poteau mountain, Indian Territory; Lower Carboniferous, Washington, Crawford, Independence and Stone counties.	Salt Range, India; China; South America; Upper Coal Measures and Permo-Carboniferous.	17
18	*Productus splendens* Norwood and Pratten.			X	Poteau mountain, Indian Territory.	Coal Measures and Permian, Mississippi valley region.	18
19	*Productus punctatus* Martin.	X	X		Conway county, 6 N., 16 W., Sec. 29.	Universal in Upper and Lower Carboniferous.	19

	FAUNA OF THE COAL MEASURES OF ARKANSAS.	LOWER CARBONIFEROUS.	LOWER COAL MEASURES.	UPPER COAL MEASURES.	LOCALITY IN ARKANSAS.	OTHER LOCALITIES.	
	BRACHIOPODA—Continued.						
20	*Productus semireticulatus* Martin.	X	X		White county, 8 N., 7 W., Secs. 33 and 26; Lower Carboniferous in Independence and Searcy counties.	Universal in Upper and Lower Carboniferous.	20
21	*Retzia radialis* Phillips.			X	Sebastian county, 8 N., 32 W., Sec. 12; and Poteau mountain, Indian Territory.	Coal Measures, Nebraska, Kansas, New Mexico, Nevada, etc.	21
22	*Rhynchonella uta* Marcou.			X	Sebastian county, 8 N., 32 W., Sec. 12; and Poteau mountain, Indian Territory.	Coal Measures, universal in the West.	22
23	*Rhynchonella*, sp.			X	Crawford county, 10 N., 32 W., Sec. 10.		23
24	*Rhynchonella*, sp.		X		White county, 8 N., 7 W., Sec. 33.		24
25	*Spirifer cameratus* Morton.		X		Sebastian county, 8 N., 32 W., Sec. 12; Poteau mountain, Indian Territory; Conway county, 6 N., 16 W., Sec. 29.	Coal Measures, universal in the West.	25
26	*Spirifer rockymontanus* Marcou.		X	X	White county, 8 N., 7 W., Sec. 33.	Coal Measures, Pennsylvania to Rocky mountains.	26
27	*Spiriferina cristata* Schlotheim.	?	X	X	Sebastian county, 8 N., 32 W., Sec. 12; Poteau mountain, Indian Territory; Conway county, 6 N., 16 W., Sec. 29; Lower Carboniferous, Marble City, Newton county.	Universal in Western Coal Measures, chiefly Upper Coal Measures.	27
28	*Derbyia crassa* Meek and Hayden.	X	X	X	Conway county, 6 N., 16 W., Sec. 29; Poteau mountain, Indian Territory.	Universal in Western Coal Measures.	28
29	*Terebratula hastata* Sowerby.		X	X	Poteau mountain, Indian Territory; Conway county, 8 N., 17 W., Sec. 33; northeast quarter of northeast quarter.	Universal in Western Coal Measures.	29

	Fauna of the Coal Measures of Arkansas.	Lower Carboniferous.	Lower Coal Measures.	Upper Coal Measures.	Locality in Arkansas.	Other Localities.	
	LAMELLIBRANCHIATA.						
30	*Astartella newberryi* Meek.		X	X	Sebastian county, 8 N., 32 W., Sec. 12; Conway county, 8 N., 17 W., Sec 33; Poteau mountain, Indian Territory.	Coal Measures, Ohio.	30
31	*Astartella vera* Hall.			X	Poteau mountain, Indian Territory.	Coal Measures, Illinois, Pennsylvania, etc.	31
32	*Aviculopecten carboniferus* Stevens.		X		White county, 8 N., 7 W., Sec. 26; Conway county, 5 N., 16 W., Sec. 17.	Coal Measures, Indiana, etc.	32
33	*Aviculopecten coxanus* Meek & Worthen			X	Poteau mountain, Indian Territory.	Coal Measures, Nebraska and Illinois.	33
34	*Aviculopecten germanus* Miller & Faber			X	Poteau mountain, Indian Territory.	Coal Measures, Kentucky.	34
35	*Aviculopecten* conf. *occidentalis* Shumard.		X		Conway county, 5 N., 16 W., Sec. 17; 6 N., 16 W., Sec. 29.	Coal Measures from Pennsylvania to Arizona.	35
36	*Conocardium* conf. *aliforme* Sowerby.		X		Conway county, 5 N., 16 W., Sec. 17.	Carboniferous, probably Upper, of England, Belgium, Germany and Russia.	36
37	*Edmondia nebrascensis* Geinitz, sp.			X	Poteau mountain, Indian Territory.	Coal Measures, Nebraska.	37
38	*Edmondia unioniformis* Phillips.		X		Conway county, 8 N., 17 W., Sec. 33.	Coal Measures, Illinois, England.	38
39	*Lima retifera* Shumard.			X	Poteau mountain, Indian Territory.	Coal Measures, Kansas, Nebraska, Texas.	39
40	*Macrodon carbonarius* Cox.		X	X	Conway county, 5 N., 16 W., Sec. 17; Poteau mountain, Indian Territory.	Coal Measures, Mississippi valley, China.	40

	Fauna of the Coal Measures of Arkansas.	Lower Carboniferous.	Lower Coal Measures.	Upper Coal Measures.	Locality in Arkansas.	Other Localities.	
	LAMELLIBRANCHIATA—Contin'd.						
41	*Macrodon obsoletus* Meek.			X	Sebastian county, 8 N., 32 W., Sec. 12; Poteau mountain, Indian Territory.	Coal Measures, West Virginia and Ohio.	41
42	*Macrodon tenuistriatus* Meek and Worthen.	X		X	Poteau mountain, Indian Territory; Moorefield, Independence county.	Upper Coal Measures, Nebraska.	42
43	*Macrodon*, sp.			X	Crawford county, 10 N., 30 W., Sec. 10.		43
44	*Nuculana* aff. *bellistriata* Stevens.			X	Scott county, 1 N., 28 W., Sec. 4.	Coal Measures, Mississippi valley.	44
45	*Nucula parva* McChesney.		X	X	Conway county, 5 N., 16 W., Sec. 17; Sebastian county, 8 N., 32 W., Sec. 12; Crawford county, 10 N., 30 W., Sec. 10.	Coal Measures, Illinois, etc.	45
46	*Nucula ventricosa* Hall.		X		Conway county, 5 N., 16 W., Sec. 17.	Coal Measures, Iowa, Pennsylvania, Texas, etc.	46
47	*Pleurophorus oblongus* Meek.		X		Conway county, 5 N., 16 W., Sec. 17.	Upper Coal Measures, Nebraska.	47
48	*Pleurophorus*, sp.			X	Scott county, 1 N., 28 W., Sec. 4.	Permian, Texas.	48
49	*Schizodus* conf. *amplus* Meek and Worthen.		X		White county, 8 N., 7 W., Sec. 33.	Coal Measures, Illinois, etc.	49
50	*Schizodus wheeleri* Swallow.		X		Conway county, 8 N., 17 W., Sec. 33.	Coal Measures of the Mississippi valley region.	50
51	*Schizodus cuneatus* Meek.		X	X	Crawford county, 10 N., 30 W., Sec. 10; Conway county, 8 N., 17 W., Sec. 33.	Lower Coal Measures, Ohio; Upper Coal Measures, Nebraska (?).	51

	Fauna of the Coal Measures of Arkansas.	Lower Carboniferous.	Lower Coal Measures.	Upper Coal Measures.	Locality in Arkansas.	Other Localities.	
	GASTEROPODA.						
52	*Bellerophon carbonarius* Cox.		X		Conway county, 5 N., 16 W., Sec. 17, and 8 N., 17 W., Sec. 33; Franklin county, 10 N., 26 W., Sec. 2.	Coal Measures, Mississippi valley.	52
53	*Bellerophon crassus* Meek & Worthen.		X		Conway county, 5 N., 16 W., Sec. 17.	Coal Measures, Pennsylvania and Western States; also Lower Carboniferous, Pennsylvania.	53
54	*Bellerophon marcouanus* Geinitz.			X	Sebastian county, 8 N., 32 W., Sec. 12.	Coal Measures, Mississippi valley.	54
55	*Bellerophon*, sp.		X		White county, 8 N., 7 W., Secs. 33 and 26.		55
56	*Euomphalus subquadratus* Meek and Worthen.		X		White county, 9 N., 5 W., Sec. 1, and 9 N., 4 W., Sec. 6.	Coal Measures, Illinois.	56
57	*Euomphalus*, sp.		X		Independence county, 11 N., 5 W., Sec. 9.		57
58	*Dentalium* conf. *meekianum* Geinitz.			X	Crawford county, 10 N., 30 W., Sec. 10.	Permo-Carboniferous, Nebraska.	58
59	*Macrocheilus* conf. *fusiformis* Hall.		X		Conway county, 5 N., 16 W., Sec. 17.	Coal Measures, Iowa.	59
60	*Macrocheilus* conf. *primigenius* Conrad		X		Conway county, 5 N., 16 W., Sec. 17.	Coal Measures, Iowa, Indiana, Ohio, Illinois.	60
61	*Naticopsis nana* Meek and Worthen.			X	Sebastian county, 8 N., 32 W., Sec. 12.	Coal Measures from Illinois to Nevada.	61
62	*Naticopsis*, sp.			X	Scott county, 1 N., 28 W., Sec. 4.	Texas Permian (?).	62
63	*Pleurotomaria modesta* Keyes.			X	Crawford county, 10 N., 30 W., Sec. 10.	Coal Measures, Kentucky and Pennsylvania.	63

	FAUNA OF THE COAL MEASURES OF ARKANSAS.	LOWER CARBONIFEROUS.	LOWER COAL MEASURES.	UPPER COAL MEASURES.	LOCALITY IN ARKANSAS.	OTHER LOCALITIES.	
	GASTEROPODA—Continued.						
64	*Pleurotomaria* conf. *speciosa* Meek and Worthen.			X	Poteau mountain, Indian Territory.	Coal Measures, Illinois.	64
65	*Pleurotomaria tenuicincta* Meek and Worthen.			X	Poteau mountain, Indian Territory.	Upper Coal Measures, Illinois.	65
66	*Pleurotomaria harii* S. A. Miller.		X		Conway county, 8 N., 17 W., Sec. 33.	Upper Coal Measures, Missouri.	66
67	*Pleurotomaria*, sp.		X		Conway county, 5 N., 16 W., Sec. 17.		67
68	*Pleurotomaria*, sp.		X		Pope county, 10 N., 20 W., Sec. 8.		68
69	*Pleurotomaria*, sp.		X		Franklin county,12 N., 28 W., Sec. 27.		69
70	*Polyphemopsis inornata* Meek and Worthen.			X	Crawford county, 10 N., 30 W., Sec. 10.	Upper Coal Measures, Illinois.	70
	PTEROPODA.						
71	*Conularia* conf. *crustula* White.			X	Scott county, 1 N., 28 W., Sec. 4.	Coal Measures, New Mexico, Missouri.	71
	CEPHALOPODA.						
72	*Goniatites* (*Gastrioceras*), sp. indet.			X	Scott county, 1 N., 28 W., Sec. 4.		72
73	*Goniatites* (*Gastrioceras*) *excelsus* Meek.		X		Pope county, 10 N., 20 W., Sec. 8.	Coal Measures, Kansas.	73
74	*Goniatites* (*Gastrioceras*) *marianus* Verneul.			X	Scott county, 1 N., 28 W., Sec. 4.	Upper Carboniferous Limestone, Ural mountains.	74

	FAUNA OF THE COAL MEASURES OF ARKANSAS.	LOWER CARBONIFEROUS.	LOWER COAL MEASURES.	UPPER COAL MEASURES.	LOCALITY IN ARKANSAS.	OTHER LOCALITIES.	
	CEPHALOPODA—Continued.						
75	*Goniatites* (*Gastrioceras*) *globulosus* Meek and Worthen.			X	Scott county, 1 N., 28 W., Sec. 4.	Upper Coal Measures, Illinois.	75
76	*Goniatites* (*Gastrioceras*) *branneri*, n. sp., J. P. Smith.		X		Carroll county, Pilot mountain, 17 N., 19 W., Sec. 18.		76
77	*Goniatites* (*Paralegoceras*) *iowensis* Meek and Worthen.		X		Conway county, 5 N., 16 W., Sec. 17.	Coal Measures, Iowa; Lower Carboniferous, Bend Formation, Texas; Upper Coal Measures, Kansas City, Mo.	77
78	*Goniatites* (*Pronorites*), sp.			X	Scott county, 1 N., 28 W., Sec. 4.	Ural mountains (?).	78
79	*Goniatites* (*Pronorites*) *cyclolobus* Phillips, var. *arkansiensis* J. P. Smith.		X		Carroll county, Pilot mountain, 17 N., 19 W., Sec. 18.	Carboniferous Limestone of England, Belgium, Russia.	79
80	*Nautilus* (*Endolobus*) *missouriensis* Swallow, (?).		X		Conway county, 5 N., 16 W., Sec. 17.	Coal Measures, Indiana, Missouri, Illinois (?).	80
81	*Nautilus* (*Ephippioceras*) *ferratus* Cox.		X		Conway county, 5 N., 16 W., Sec. 17; White county near Searcy.	Coal Measures, Kentucky.	81
82	*Nautilus*, sp.			X	Crawford county, 10 N., 30 W., Sec. 10.		82
83	*Orthoceras cribrosum* Geinitz.			X	Poteau mountain, Indian Territory.	Coal Measures, Nebraska.	83
84	*Orthoceras* conf. *rushense* McChesney.			X	Scott county, 1 N., 28 W., Sec. 4.	Coal Measures and Permian, Texas, etc.	84
85	*Orthoceras*, sp.		X		Conway county, 8 N., 17 W., Sec. 33.		85

	Fauna of the Coal Measures of Arkansas.	Lower Carboniferous.	Lower Coal Measures.	Upper Coal Measures.	Locality in Arkansas.	Other Localities.	
	CRUSTACEA.						
86	*Phillipsia cliftonensis* Shumard.			X	Poteau mountain, Indian Territory.	Upper Coal Measures and Permo-Carboniferous of Kansas.	86
87	*Phillipsia* (*Griffithides*) *scitula* Meek and Worthen.		X		White county, 9 N., 4 W., Sec. 6, and 9 N., 5 W., Sec. 1; Conway county, 5 N., 16 W., Sec. 17.	Coal Measures, Illinois and Nebraska.	87
88	*Phillipsia*, sp.		X		Johnson county, 11 N., 24 W., Sec. 26.		88
89	*Phillipsia* (*Griffithides*) *ornata* Vogdes.		X		Conway county, 5 N., 16 W., Sec, 17.		89
	Prestwichia (?).		X		White county, 9 N., 4 W., Sec. 6.		90

EXPLANATION OF PLATES.

[Where not otherwise stated the figures are all natural size.]

PLATE XVI.

Fig. 1. *Gastrioceras marianum* Verneul........................... 50

1 *a*. Side view.

1 *b*. Rear view.

Fig. 2. *G. marianum*, artificial cast, magnified twice.

2 *a*. Front view.

2 *b*. Side view.

Fig. 3. *G. marianum*, largest specimen.

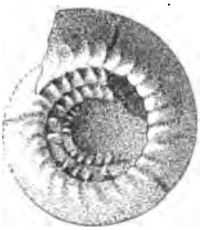
3 *a*. Side view.

3 *b*. Cross section of whorl.

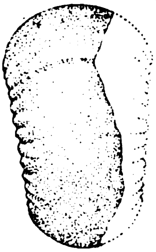
Fig. 4. *G. marianum*, artificial cast.

Fig. 5. *a*, *b*, *c*. *G. marianum*, showing the development of the sutures.

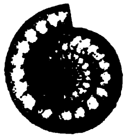
1 a

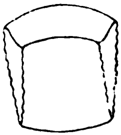


1 b



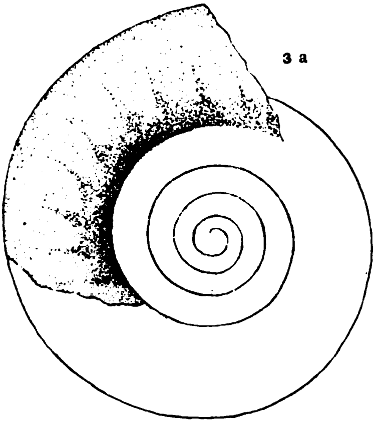
2 b



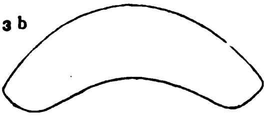


2 a

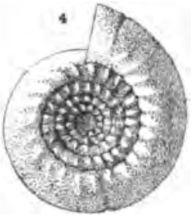
3 a



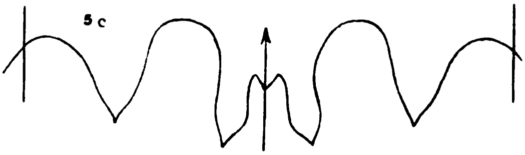
3 b



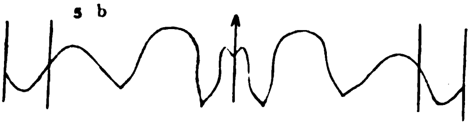
4



5 c



5 b



5 a

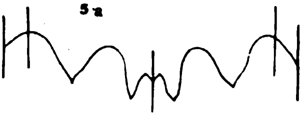


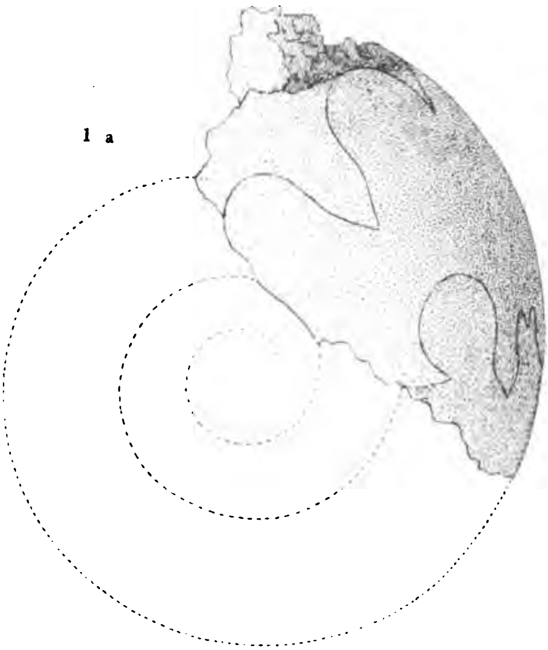
PLATE XVII.

Fig. 1. *Gastrioceras excelsum* Meek................................ 50

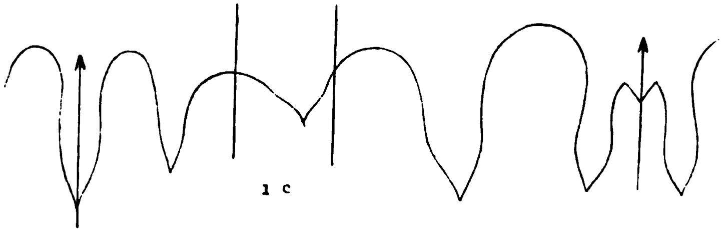
1 *a*. Side view.

1 *b*. Cross section of whorl.

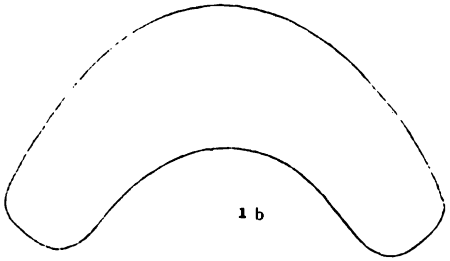
1 *c*. Sutures.



1 a



1 c



1 b

Plate XVIII.

Fig. 1. *Gastrioceras globulosum* Meek and Worthen.............. 48

1 *a.* Side view of small specimen.

1 *b.* Front view of small specimen.

Fig. 2. *G. globulosum*, artificial cast from a mould.

2 *a.* Side view.

2 *b.* Front view.

Fig. 3. *G. globulosum*, sutures, enlarged twice.

Fig. 4. *G. globulosum*, cast showing surface markings.

Fig. 5. *G. globulosum*, small globose specimen doubtfully referred to this species.

5 *a.* Front view.

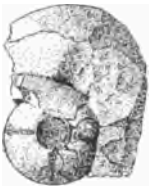
5 *b.* Side view.

Fig. 6. *G. globulosum*, small specimen showing the low flattened whorl.

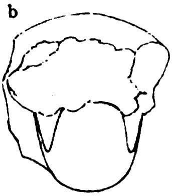
6 *a.* Side view.

6 *b.* Front view.

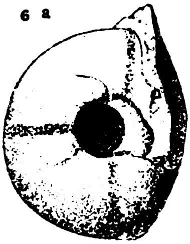
1 a



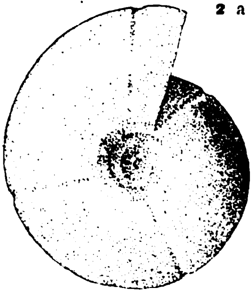
1 b



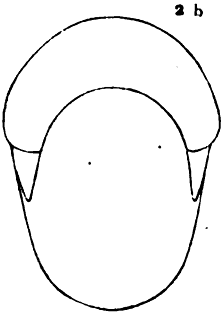
6 a



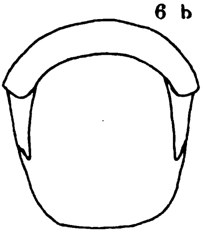
2 a



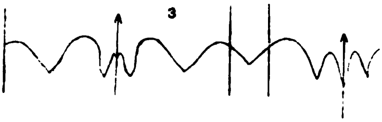
2 b



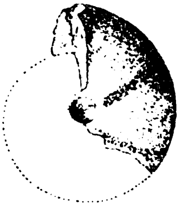
6 b



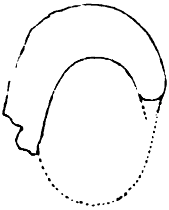
3



5 b



5 a



4

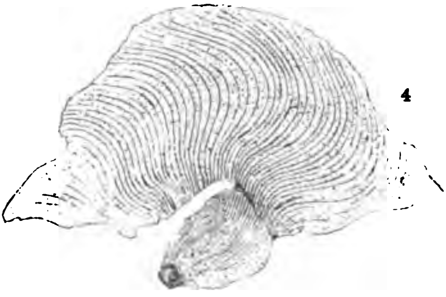


PLATE XIX.

Fig. 1. *Paralegoceras iowense* Meek and Worthen................. 53

1 *a*. Side view, partly restored.

1 *b*. Front view.

Fig. 2. *P. iowense*, inner whorl taken out of the large specimen shown in Fig. 1.

2 *a*. Side view.

2 *b*. Front view.

Fig. 3. *P. iowense*, sutures.

3 *a*. Sutures taken from the inner whorl of 25 millimeters diameter.

3 *b*. Sutures on the outer whorl.

Fig. 4. *Glyphioceras diadema* Goldfuss, showing development of the sutures (after Branco, *Palæontographica*, Vol. xxvii, Pl. ix, Fig. 1).

4 *a*. First suture.

4 *b*. Second suture.

4 *c*. Third suture.

4 *d*. At 1.25 millimetres diameter.

4 *e*. At 2.25 millimetres.

4 *f*. Adult.

Fig. 5. *Tornoceras retrorsum* v. Buch (after Branco).

5 *a*. First suture.

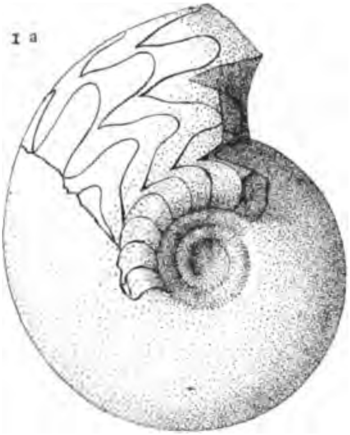
5 *b*. Second suture.

5 *c*. At 1.75 millimetres diameter.

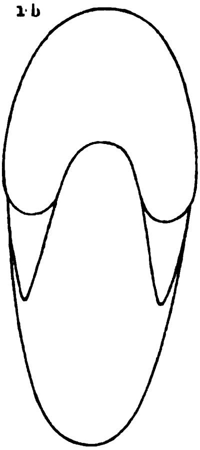
5 *d*. At 2.50 millimetres.

5 *e*. At 10 millimetres, adult.

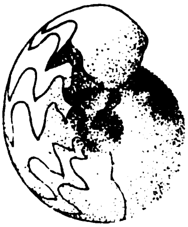
1 a



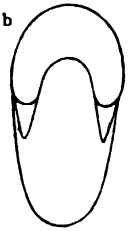
1 b



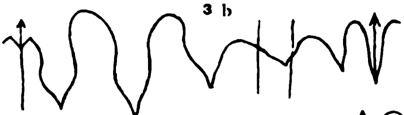
2 a



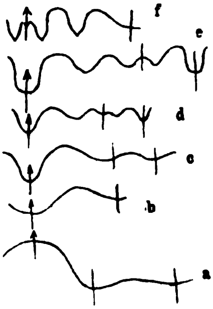
2 b



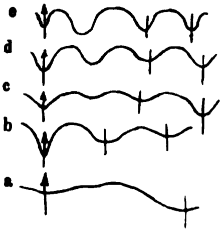
3 b



4



5



3. a

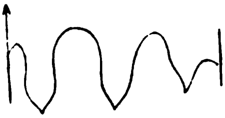


Plate XX.

Fig. 1. *Gastrioceras*, sp. indet. 52

1 *a*. Side view of a composite artificial cast, from three specimens.

1 *b*. Side view of a septate fragment.

1 *c*. Cross section of whorl.

1 *d*. Sutures.

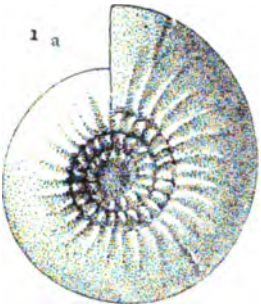
Fig. 2. *Pronorites*, sp. 60

2 *a*. Side view of septate fragment.

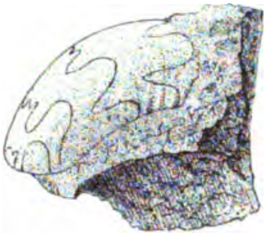
2 *b*. Cross section of whorl.

2 *c*. Sutures.

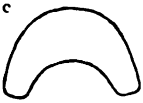
1 a

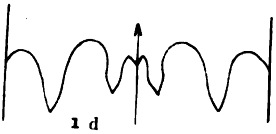


1 b



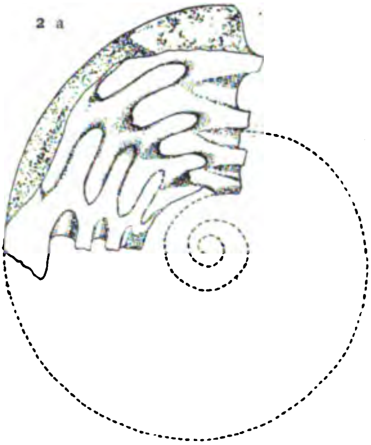
1 c

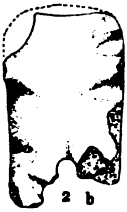




1 d

2 a





2 b

2 c

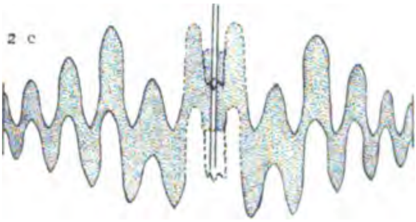


PLATE XXI.

Fig. 1. *Endolobus missouriensis* Swallow........................ 42

1. Side view of large specimen.

Fig. 2. *Endolobus missouriensis* Swallow.

2 *a*. Side view of small specimen.

2 *b*. Rear view of small specimen.

2 *c*. Front view of small specimen, twice enlarged

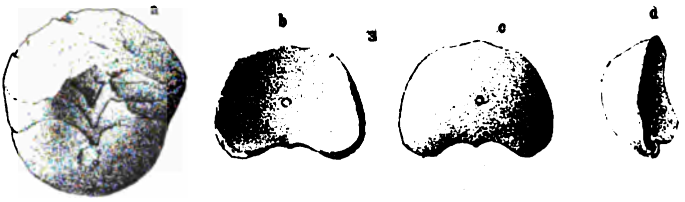
Fig. 3. *Endolobus missouriensis* Swallow.

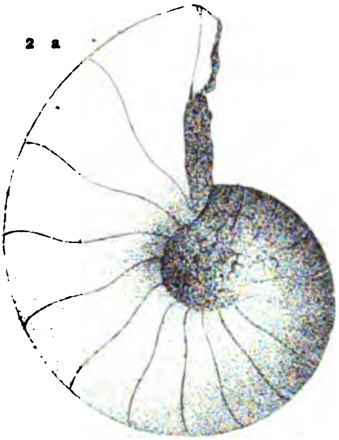
3 *a*. Dorsal view, showing internal lobe.

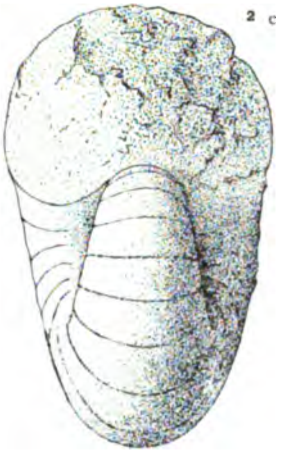
3 *b*. Concave side of chamber.

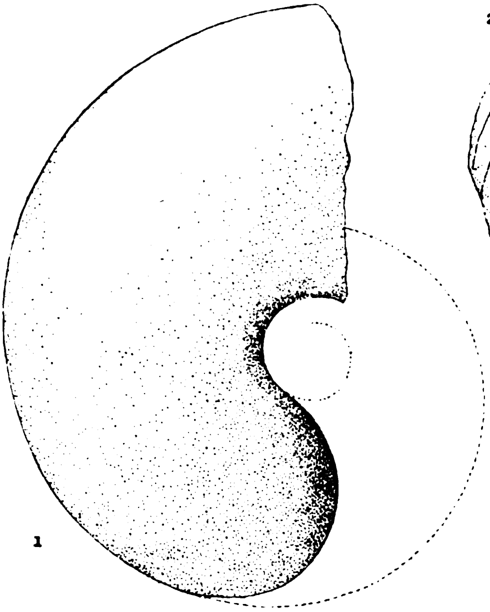
3 *c*. Convex side of chamber.

3 *d*. Chamber, from the side.


3


2 a


2 c


1

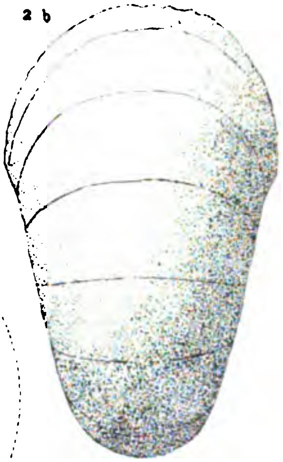
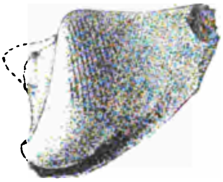
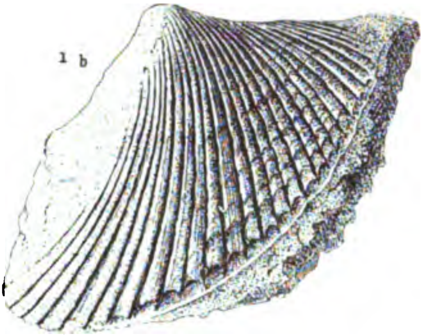

2 b

PLATE XXII.

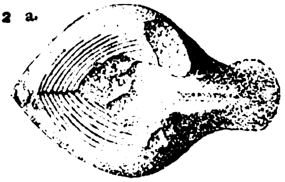
Fig. 1. *Conocardium aliforme* Sowerby........................... 37
  1 *a*. Side view, natural size.
  1 *b*. Side view of another specimen, twice enlarged.
Fig. 2. *Conocardium aliforme* Sowerby.
  2 *a*. Another specimen, from above.
  2 *b* From front.
  2 *c*. From side.
Fig. 3. *Schizodus cuneatus* Meek................................. 35
  3 *a*. Side view.
  3 *b*. Front view.
Fig. 4. *Schizodus wheeleri* Swallow 36
Fig. 5. *Phillipsia cliftonensis* Shumard.......................... 60
  5 *a*. From above, twice enlarged.
  5 *b*. Side view, twice enlarged.
Fig. 6. *Phillipsia* (*Griffithides*) *ornata* Vogdes, twice enlarged..... 61

1 a

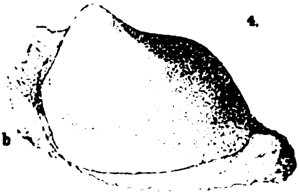




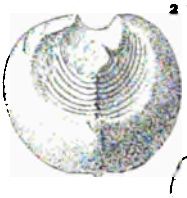
2 a.



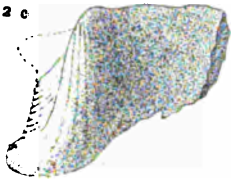
4.

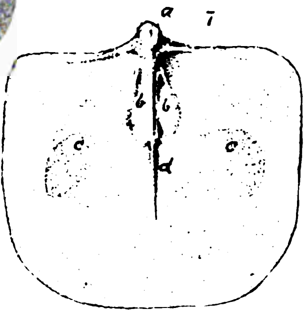


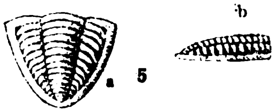
2 b



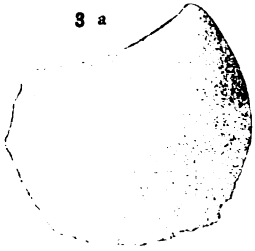
2 c







3 a



3 b

6

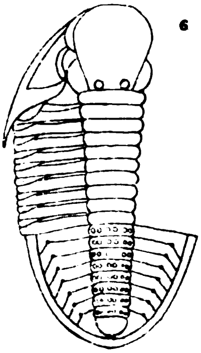


PLATE XXIV.

Pronorites cyclolobus Phillips (variety ***arkansiensis*** J. P. Smith).... 57

Fig. 1. Side view, Arkansas specimen.

Fig. 2. Rear view, Arkansas specimen.

Fig. 3. Front view, Arkansas specimen.

Fig. 4. Sutures, Arkansas specimen.

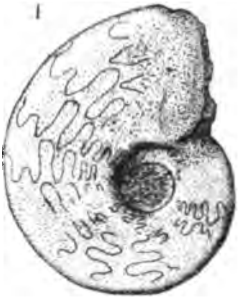
Fig. 5. Side view of Ural Mountains specimen (after Karpinsky, *Ammoneen d. Artinsk-Stufe*, Pl. i, Fig. 4 *a*, *b*).

Fig. 6. (After Karpinsky, *Ammoneen d. Artinsk-Stufe*, Pl. i, Fig. 4 *n*.)

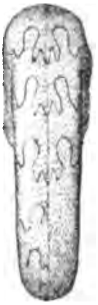
Fig. 7. (After Karpinsky, *Ammoneen d. Artinsk-Stufe*, Pl. i, Fig. 4 *m*.)

Fig. 8. (After Karpinsky, *Ammoneen d. Artinsk-Stufe*, Pl. i, Fig. 4 *e*, *f*.)

Fig. 9. Showing development of the sutures, from the Ibergiceras to the Pronorites stage, after Karpinsky (Pl. i, Fig. 4 *g*–*l*).

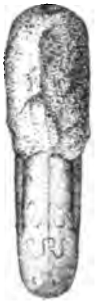


1

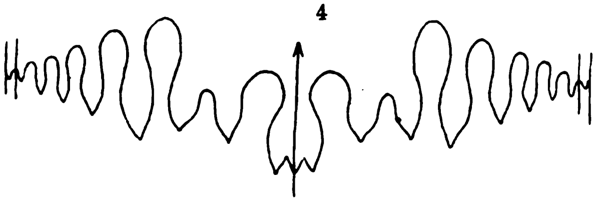


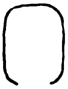
2

3

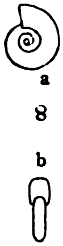


4



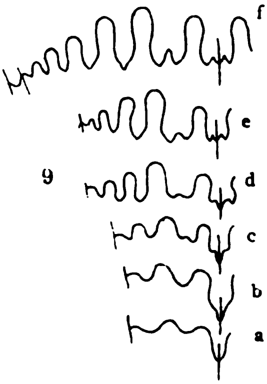


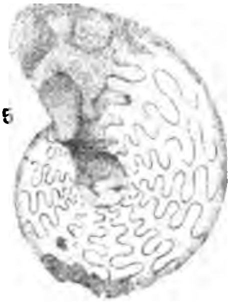
6



8

9





5

7

UNIVERSITY OF MICHIGAN
3 9015 06830 8207